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CONTRIBUIÇÃO DO ESTUDO DA DIVERSIDADE E TRATAMENTOS DENTÁRIOS E SUA UTILIDADE NA IDENTIFICAÇÃO FORENSE

THE CONTRIBUTION OF THE STUDY OF DIVERSITY AND DENTAL TREATMENT AND ITS UTILITY IN FORENSIC IDENTIFICATION

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Tese da candidatura ao grau de Doutor em Ciências Médicas, submetida ao Instituto de Ciências Biomédicas de Abel Salazar da Universidade do Porto.

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Dedicatória/
Dedication

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Publications and Communications

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Abbreviations List

ABFO – American Board of Forensic Odontology.

DNA – Deoxyribonucleic acid.

AM – Ante-mortem.

DVI – Disaster victim identification.

FDI – World Dental Association.

PM – Post-mortem.

NATO - North Atlantic Treaty Organization.

EU – European Union.

Resumo

A medicina dentária forense tem muito para oferecer na aplicação da lei, na deteção e solução do crime ou em processos civis. O trabalho do médico dentista forense requer um conhecimento interdisciplinar da ciência dentária. Na maioria das vezes, o papel destes profissionais é estabelecer a identidade de uma pessoa. As peças dentárias, com as suas variações fisiológicas e formas, registam informações que permanecem ao longo da vida e mais além. Estes profissionais de saúde têm um papel importante a desempenhar na manutenção de registos dentários precisos e a fornecem todas as informações necessárias para que as autoridades legais possam reconhecer negligência, fraude ou abuso e/ ou coadjuvar na identificação humana sempre que lhes seja solicitado. No entanto, uma das principais dificuldades que se encontra na identificação dentária é a escassez de dados epidemiológicos sobre a distribuição das frequências das diversas situações clínicas (patologia e tratamentos), para cada peça dentária numa população de diferentes origens.

Com a finalidade de contribuir para o conhecimento da diversidade das distintas situações clínicas dentárias, de uma população militar portuguesa e posteriormente comparar com a população militar espanhola, desenvolveu-se uma base de dados com as características clínicas de cada peça dentária.

As características clínicas dentárias foram registadas nos seus respetivos odontogramas, utilizando a classificação estabelecida pela Federação Dentária Internacional, utilizando para o efeito o sistema *Forensic Dental Symbols*®, e para tratamento e análise, a base de dados *Dental Encoder*® projetado e adaptado às formas dentárias de *Disaster Victim Identification*, proposto pela INTERPOL, assim como o *Microsoft*® *Office Excel* e SPSS versão 23.0. A codificação genérica foi a codificação escolhida, pois agrupa as condições clínicas (não restaurado, restaurado, ausente ou coroa) similares na mesma categoria, com a finalidade de analisar os resultados a partir dos dados mais limitados.

Apresentam-se os resultados encontrados, utilizando um sistema de codificação genérica, dos possíveis tratamentos dentários para assim obter conclusões sobre as frequências e distribuição dos tratamentos dentários. Concluímos a importância da existência destas bases de dados para a estimativa da probabilidade de identificação humana.

Com este trabalho pretendemos fornecer informações potencialmente úteis sobre a importância das bases de dados de registos dentários e seu valor para fins de identificação humana.

Abstract

Forensic Odontology has a lot to offer to law enforcement, crime detection and solution, and civil actions. The job of a forensic odontologist requires an interdisciplinary knowledge of dental sciences. Most of the time, these professionals' role is to establish the identity of a person. The dental pieces, in their shapes and physiological variations, track information that remains throughout a person's life and beyond. These healthcare professionals have an important role to play in the maintenance of accurate dental records and can provide all the required information for the legal authorities to recognize negligence, fraud or abuse, and/or help in human identification whenever required. However, one of the main challenges of dental identification is the lack of epidemiological data about the distribution of the frequency of several clinical situations (pathologies and treatments) for each dental piece in a population from different origins.

With the aim of contributing to the understanding of the diversity of the several dental clinical situations of a Portuguese military population and posteriorly compare it with a Spanish military population, a database with the clinical characteristics of each dental piece was created.

The dental clinical characteristics were recorded in their corresponding dental charts, using the Forensic Dental Symbols® system, based on the classification established by the World Dental Association. The data were then treated and analyzed using the Dental Encoder® database, which was projected and adapted to the Disaster Victim Identification's dental forms as proposed by INTERPOL, as well as the Microsoft® Office Excel and the SPSS version 23.0 software. The generic codification was the chosen codification system, as it groups similar clinical conditions (unrestored, restored, missing or crown) into the same category for the results to be analyzed from more limited data.

The results of the potential dental treatments are here presented, using the generic codification system, and, thus, conclusions can be drawn on the frequencies and distribution of dental treatments. We concluded that the existence of these databases is important to estimate the probability of human identification.

With this work, we aim to provide potentially useful information on the importance of dental records databases and their value for human identification purposes.

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Chapter I. - Introduction

Forensic Odontology was defined by Keiser-Nielson in 1970 as the branch of Forensic Medicine that, in the interest of justice, is responsible for the proper handling and examination of dental evidence and the appropriate assessment and presentation of dental findings. This definition is still as true today as it was in 1970 and represents the overlap between the dentist and the jurist professions. The use of dental records for forensic identification has increased in the past two decades and is well accepted worldwide (Gupta *et al.*, 2016; Krishan, Kanchan, Garg, 2015; Waleed *et al.*, 2015; Hinchliffe, 2011).

The reasons for identifying people may be diverse and of various natures, from religious or ethical reasons to reasons related to rights, obligations or responsibilities, not only from the civil point of view but also from the criminal one (Sahelangi, Novita, 2012; Pretty and Sweet, 2001).

Sometimes, the victims' bodies are destroyed by the action of physical, chemical, mechanical or biological agents, resulting in skeletonized, fragmented, burnt or mutilated bodies, or even bodies in an advanced state of decomposition, which makes the recognition based only on visual inspection, deoxyribonucleic acid (DNA) or dactyloscopic methods difficult or impossible (Obafunwa *et al.*, 2015; Lake, James, Berketa, 2012; Valenzuela, 2000). In these situations, the human dentition is more likely to be intact and, thus, provide useful information for the identification.

Dental pieces and jaws are known to have a wide variety of individual characteristics that can help in that process. These anatomical landmarks, their physical characteristics and the associated pathological processes are often available in the dental chart, x-rays and diagnostic casts. Those records from before death are important evidence and, sometimes, the only available evidence for determining the body's identity. Missing or impacted teeth, restorations and/or prostheses, the dental morphology, the bone trabeculae, the presence of caries and periodontal disease are characteristics commonly used for comparisons (Gupta *et al.*, 2016; Wood, 2014; Sahelangi and Novita, 2012; Glass, 2002; Wood, Tal Blenkinsop, Johnston, 1994).

The methods used in dental identification are quite simple, as they involve comparing the known, identifiable ante-mortem (AM) material with the post-mortem (PM) elements. The identification fits within one of the following categories: (ABFO, 2017; Hill, Hewson, Lain, 2011a; Dorion, 1990).

- positive: the AM and PM data are a match in enough details to allow establishing that they belong to the same person. Also, there are no known discrepancies;

- potential - the AM and PM data have consistent characteristics but, due to the quality of those elements, it is possible to establish a dental identification;

- insufficient evidence: the information available is not enough to provide a basis for a conclusion;

- exclusion: the AM and PM data are clearly inconsistent. In some cases, the identification by exclusion is a valid technique.

The identity is a set of characteristics that individualize a person, making them unique on their own and different from the others (França, 2008). These characteristics may be physical (population affinity, gender, age, height, malformations, scars, tattoos, professional signs, individual signs, biotype), functional (attitude, mimics, gestures, locomotion, sensorial functions, voice, writing) or psychic (based on psychic activities from childhood to old age, including personality traits, temper and intelligence) (Pramod, Marya, Sharma, 2012; França GV, 1998; Keiser-Nielsen S, 1963).

Although dental identification is not an innovative methodology, as it is well-known, its use still has much room for improvement to be able to contribute to accomplishing better final results. “Identify” is defined as to “establish or indicate who or what (someone or something) is”; on the other hand, “recognize” means to “identify (someone or something) from having encountered them before; know again” (The Oxford English Dictionary, 2018).

In forensics practice, human identification procedures (Arora e Kaur, 2016; Balachander, 2015; Pittayapat *et al.*, 2012; Kolude, 2010; Valenzuela e Martín-de-las-Heras, 2004; Reverte, 1999; Moya, Roldán e Sánchez, 1994) may be required to identify:

- alive individuals: in cases such as missing persons, personality theft and even paternity disputes. In some situations, the need for identification is associated with mentally ill patients, pathological conditions that involve amnesia or consciousness disorders, and also minors that do not have family, friends or valid documents to help with their identification;

- recent corpses: in cases of extensive destruction or poor conservation of corpses, where their identification is not always easy, which can lead to using different methodologies, according to the corpse's state of conservation;

- skeletonized remains: in cases such as advanced putrefaction, aircraft accidents and dismemberments, in which the expert has to identify isolated cadaveric remains, bones and/or teeth instead of a whole corpse. In these circumstances, the forensic expert examination aims to obtain information for three different forensic aspects: identify the body or cadaveric remains, contribute to the establishment of a date, and contribute with elements that allow withdrawing conclusions on the form and mechanism of the death.

An identification method is every factual or circumstantial element or technique that contributes or may contribute to the correct identification of human remains, either by confirming or definitely excluding a specific identity. The various techniques used have distinct scientific importance for the identification, and the most reliable scientifically based identification methods are the analysis of fingerprints, the DNA profiles and the dental study. Secondary or circumstantial methods, which help reinforce or guide the identification but are not sufficient to prove it on their own, include the personal description, medical data, and objects, documents and clothing.

The procedures for corpse identification vary depending on multiple factors. The extensive destruction or poor conservation of bodies affects the nature and quality of the PM information and, consequently, the viability of using some procedures. The methodology used in each procedure also varies according to the information previously available. In general, most identification procedures should follow different methodologies depending on whether the purpose is a reconstructive identification or a comparative identification.

The human identification methods, according to Sassouni, can be divided into two categories (Metcalf, Klim-Lemann, 2015; Dostálová, 2008; Brown, 2007; Sassouni, 1963):

- reconstructive methods: methods most commonly used when cadaveric remains, either skeletonized or not, are found and, in a first approach, do not provide enough data to identify a particular person. In these cases, contributions with the maximum information possible are required to become closer to knowing the identity.

These methods include investigating the available material to extract the maximum amount of information about the person to be identified. Information such as gender, biotype, age, height and individual characteristics of the corpse indicate possibilities and probabilities regarding the person under identification, based on the reconstruction of the biological profile;

- comparative techniques - methods used when the cadaveric remains must be compared with the corresponding data of a missing person. This identification process is based on the existence of previous records, AM, that must be compared with the PM data, and is the one used in massive disasters with a great number of mortal victims. In identification processes where the usual techniques are not enough, mostly skeletonized or burnt corpses, these methods are of great value and the process often reaches significant effectiveness (Valenzuela *et al.*, 2002).

Every procedure applied in the identification should have scientific validity and be reliable, able of being conducted within a reasonable period, adapted to each context and applied by trained expert professionals. The identification process is multidisciplinary and, thus, every available procedure should be used together, bearing in mind that the most correct and adequate approximation to human identification is the one conducted based on the combination of several coincident criteria (Wadhwani, Shetty, Sreelatha, 2017; Bhullar *et al.*, 2014; Saks, 2010; Funaro, 2006; Himmelberger, 2002; Martín-de-las-Heras *et al.*, 1999; Lessig e Edelmann, 1995; Andersen *et al.*, 1995; Sognnaes, 1977; Keiser-Nielsen, 1963).

1. Dental analysis

According to the Disaster Victim Identification (DVI) (INTERPOL, 2014), the unique structures and characteristics of human teeth and arches are readily available to be used in the identification of alive victims and corpses. Dental records can be obtained during the PM examination and compared with AM elements provided by the victim's dentists.

Due to their unique nature, the structures and characteristics of dental pieces and jaws are ideal for the identification of victims (Guimarães, 2017; Waleed *et al.*, 2015; Riley, 2015; Pittayapat *et al.*, 2012; Hinchliffe, 2011; Kolude, 2010; Sweet, 2010; Guimarães, 2009; Valenzuela and Martín-de-las-Heras, 2004; Pretty and Sweet, 2001; Brkić *et al.*, 2000b; Moya, Roldán and Sánchez, 1994; Friedrich, 1989; Sognnaes,

1977). The dental analysis is reliable because the teeth are protected in the oral cavity and withstand well the effects of the exterior environment before, during and after death. Moreover, since the teeth are the hardest and most resistant structures of the organism, even if the body's soft tissues deteriorate, the dental characteristics will conserve their integrity.

Human teeth go through several stages of development from the womb to adulthood, and these stages of their eruption and evolution may be useful for estimating the age of a person at their time of death. The teeth and the jaws may present congenital characteristics and characteristics acquired throughout life that help identify the population affinity, diet and oral hygiene of a person. Dental treatments, such as restorations and crowns, devitalizations and dental prostheses are individualized treatments that are unique for each person. Depending on the type of dental procedure found, it may be possible to determine the country or region of origin of one particular victim.

The characteristics of each tooth, namely, its color, erosion, cleanliness and presence of malformations, as well as the type of tooth (primary or permanent), are also relevant. The understanding of the normal anatomical properties of human teeth, both macroscopic and microscopic, is of great interest to the expert dentist (Stow, James, Richards, 2016, Gupta *et al.*, 2016; Waleed *et al.*, 2015; Pereira and Santos, 2013; Astekar *et al.*, 2011; Adams, 2003; Kraft, Liebhardt and Lindemaier, 1991; Friedman, Cornwell, Lorton, 1989; Silva 1997). The study of the teeth and oral structures by diverse techniques provides most valuable information on a person's characteristics. In fact, the Spanish forensic doctor Professor Reverte Coma was right to refer to the mouth as “the body's black box.” The naturalist Cuvier also said: “give me a tooth and I will tell you its number, if it is from a human or from an animal” (Eckert, 1996). The information obtained is of the utmost importance and should be considered in identification processes of both alive individuals and recent corpses, skeletons or cadaveric remains (Avon, 2004). All the mentioned characteristics are important when examining a tooth, to verify if it is from a human or an animal, if it is primary or permanent, if it is superior or inferior, and what group it belongs to (incisors, canines, pre-molars or molars). Other relevant aspects for the identification of corpses are missing, fractured and worn teeth, inlays and any mechanical agent that causes lesions since, when identified, they can provide valuable information for human identification.

In normal conditions, human dental pieces present three clinically visible dental aspects in each of the thirty-two teeth in the permanent dentition, making a total of ninety-six surfaces, and twenty teeth in the primary dentition, totaling sixty surfaces. The combination of restored aspects, missing teeth, anomalies, prostheses, size variations, arch forms and other variables lead to individualization, thus being extremely useful in identification processes (Waleed *et al.*, 2015; Guimarães, 2009; Libourel, 1982; Mertz, 1977).

Due to the wide range of particularities provided by the oral cavity, it has on its own the status of an individualizing and differentiating factor in the establishment of a person's identity (Biazevic, 2011; Martín-de-las-heras, 2010; Adams, 2003; Lessig and Edelmann, 1995; Holt, 1981). The variability degree is so high that one can categorically state that there are no two persons with the same dental characteristics. Individualizing oral characteristics, which may be found in soft tissues or dental tissues, were traditionally classified as “ordinary” or “extraordinary” according to the frequency with which they occur in the general population (Keiser-Nielsen, 1977). These characteristics have the utmost value in the forensic process of comparative identification since they can confirm the identity of a person or exclude a person considering a limited population.

2. Dental diversity

Dental pieces have excellent characteristics as they are the most resistant, immutable and durable body structures when subjected to external physical factors such as trauma or heat, as well as chemical or biological factors and putrefaction. Due to the range of individualizing characteristics provided by dental pieces, changes in morphology and position, pathologies, dental treatments, prostheses, among others, it is currently accepted that no two persons have the same dentition.

The dental characteristics that provide most information are described below:

- *number of teeth*: The permanent human dentition is composed of 32 teeth and the primary dentition of 20 teeth. This change in the number of teeth may be of great help as a differentiating characteristic to establish identity. Other differentiating characteristics related to the number of teeth are hyperdontia, also known as supernumerary teeth, tooth agenesis or hypodontia and impacted teeth (Bilge *et al.*, 2017; Tewari, Pandey, Singh, 2017; Ledesma-Montes *et al.*, 2016; Yassin, 2016; Aren *et al.*, 2015; Patil, Maheshwari, 2014; Tinoco *et al.*, 2010; Guimarães, 2009; Dahlberg, 1985).

- *change in size and shape*: These changes can also be differentiating characteristics. The most important variants of tooth size are macrodontia and microdontia, and the variants of tooth shape include fusion, gemination, concrescence, dilaceration, dens in dente or dens invaginatus, taurodontism, hypercementosis and supernumerary roots (Bilge *et al.*, 2017; Cassia *et al.*, 2017; Jamshidi *et al.*, 2017; Yassin, 2016; Aren *et al.*, 2015; Guimarães, 2009; Brkić *et al.*, 2000a; Lunt, 1974).

- *change in position*: The great value of these changes as individualizing characteristics relies on the multiple combinations they may present, with different degrees and types of malformation (Bilge *et al.*, 2017; Yassin, 2016; Aren *et al.*, 2015; Guimarães, 2009; Brkić *et al.*, 2000a). Frequent changes in position include dental crowding and tooth rotation, among others, and less frequent ones include transpositions and ectopic eruptions.

- *changes in the occlusion*: Although these are also changes in position, they should be analyzed separately because they involve several dental pieces and imply functional, aesthetic and therapeutic repercussions. In the sagittal plane, they may be defined according to Angle's class I, II or III. In the transverse plane, there may be crossbites and midline deviations. In the vertical plane, there may be open bites and deep overbites (Fiorin *et al.*, 2017; Fiorin *et al.*, 2014; Aren *et al.*, 2015; Guimarães, 2009; Muller *et al*., 2001; Whittaker, Richards, Jones, 1998).

- *changes in structure and color*: Among the changes in color that may act as individualizing characteristics are dental fluorosis, discoloration caused by drugs, namely tetracyclines, and also amelogenesis imperfecta and dentinogenesis imperfecta (Masood, Benavides, 2018; Bilge *et al.*, 2017; Cassia *et al.*, 2017; Foulds, 2017; Yassin, 2016; Thomas and Denny, 2014; Guimarães, 2009).

- *habits*: Certain habits may be individualizing, such as playing the saxophone, oboe or clarinet, using a tongue, labial or dental piercing, smoking pipes, liking to eat lemons or experiencing bruxism (Cardoza, Wood, 2015; Metcalf, Klim-Lemann, 2015; Sweet, 2010; Guimarães, 2009; Slabbert, Ackermann, Altini, 1991).

- *pathologies*: Pathologies such as caries or periodontal disease, when properly documented, may help in identification processes (Foulds, 2017; Popoola, Onyejaka, Folayan, 2016; Chatterjee, 2011; Guimarães, 2009; Ohtani, Chiba, Yoshioka, 2009; Friedrich, Ulbricht, Maydell, 2003; Morgan, 2001).

- *restorations*: Restorations are widely varied and unique treatments since a dentist cannot reproduce exactly the same treatment twice, try as they might. These are durable treatments and the materials usually used are resistant to the effect of external agents. The aspect(s) involved in restoration may also represent a differentiating factor in identification (Vandrangi *et al.*, 2016; Pol, Ghige, Gosavi, Hazarey, 2015; Hill, Lain, Bagdey *et al.*, 2014; Hewson, 2011b; Patidar, Parwani, Wanjari, 2010; Guimarães, 2009; Bush, Bush, Miller, 2006; Aboshi, Takahashi, Komuro, 2006; Rossouw *et al.*, 1999; De Villiers Phillips, 1998).

- *root treatments*: Endodontic treatments and apicoectomies are important not only because of the treatment's specificity but also because of the sequential treatment, as they imply taking dental x-rays (Khalid, Yousif, Satti, 2016; Silva *et al.*, 2016; Silva *et al.*, 2014; Forrest, Wu, 2010; Zondag, Phillips, 2009; Phillips, Stuhlinger, 2009a; Phillips, Stuhlinger, 2009b; Guimarães, 2009; Bonavilla *et al*., 2008).

- *dental prostheses*: The multiple combinations and available designs of prostheses are widely diverse. Both due to their unique characteristics and to the fact that they only fit in a certain individual arch, these treatments are an invaluable help in identification (Berketa, James, Marino, 2010, 2011; Guimarães, 2009; Merlati *et al*., 2002, Marella, Rossi, 1999). Moreover, it is possible to mark prostheses with elements that relate them to the person wearing them (Bathala, 2016; Pereira, Santos, 2013; Mohan, Kumar, Simon, 2012; Nuzzolese, Marcario, Di Vella, 2010; Datta, Sood, 2010; Richmond, Pretty, 2009, 2006).

The recognition of the individualizing characteristics of dental pieces and, in general, of oral-related data, implies a specialized process that absolutely requires the collaboration of forensic odontologists with experience in this filed, who should have the required training and expertise to collect records, accurately interpret the results and adequately withdraw conclusions (Stoeckel, Merkley, McGivney, 2007; Soomer *et al*., 2003; Robinson, Haywood, David, 1998; Sand, Rasmusson, Borrman, 1994; Ekstrom, Johnsson, Borrman, 1993).

3. The need for improving dental identification processes

3.1 Dental data codification

According to the dictionary, "codify" means to "arrange (laws or rules) into a systematic code" and "code" means "a system of words, letters, figures, or symbols used to represent others, especially for the purposes of secrecy" (The Oxford English Dictionary, 2018). Therefore, to codify is to convert information to be communicated through a specific system of signs and rules. The codification is the state of that information exchanged between sender and receiver, which is mediated by a system determined by symbols and rules that allow its formulation and comprehension.

That information may be collected in a manual way and in writing, but it is increasingly being stored in computerized form. In the latter case, each professional acquires a certain commercial software for the management of their dental practice, and the manufacturers of different software programs apply different codifications to describe classify and store information related to the pathologies and treatments of each tooth. In Portugal, the World Dental Association (FDI) system is the one recommended by the Portuguese Dental Association.

Therefore, several computer programs have been developed for Forensic Odontology to help in the identification process. These programs consist essentially in an ordered combination of AM and PM dental records. Every data produced in the examination that is introduced into the system and is similar to the data of the filed records will, in a first stage, provide one or several possibilities for obtaining a positive identification. On the other hand, the records that are introduced into the system and contain unmatched data, after professional revision and audit, are introduced into the system's database. These software programs contribute to improving the quality and resolution in dental identification, as they can be used in cases where only isolated corpses need to be identified, as well as in big catastrophes with multiple victims.

These new technologies may be used in Forensic Odontology to help organize the records. If the AM and PM dental records are combined, the likelihood of a positive identification increases, as the forensic odontologist, after comparing the records and radiographic evidence, can make an identification. These technologies have been used in many situations, namely in mass disasters, such as the tragic tsunami in Asia. In that catastrophe, thousands of people died and, by comparing the dental records, it was possible to positively identify more than 80% of foreign tourists (Schou and Knudsen, 2012; Petju *et al.*, 2007; Guimarães, 2009; Kieser, Laing and Herbison, 2006; Tan P-H, 2005). Some authors (Syrjanen, Sainio, 1990) state that these technologies should allow forensic odontologists to work with dental fragments as effectively as with a complete dentition. The main limitations of these techniques are inappropriate AM dental records; legal complications, which may be significantly reduced by using solid forensic procedures and proper documentation; and fragmentation of the dental material. According to Wood, Tal Blenkinsop and Johnston (1994), technological advances have simplified the task of storing data in dental identification. Computerized dental records provide an easy, quick method of eliminating unlikely combinations and establishing potential candidates for identification in mass disasters.

Dorin (1990) stated that the use of informatics is a mean and not an end since the identification is the result of reasoning and logic. Informatics helps organize, store, preserve, analyze and transmit data, thus reducing time and costs. The use of informatics in identification processes, mainly in mass disasters, makes the filing and the combination of AM and PM records easier. However, identification is the result of a process of human thought (Neville, Damm, Allen, Bouquot, 1998).

With the aim of making the transcription of dental information and its posterior statistical analysis easier, a database named Dental Encoder© was developed using the Microsoft® Office Access software. This application uses the typographic font Forensic Dental Symbols©, and was developed to facilitate the introduction, codification, management and storage of dental data and of the dental charts created (Martínez-Chicón, 2013; Martínez-Chicón, 2012; Martínez-Chicón, 2008).

The Dental Encoder establishes a direct relationship between each clinical condition and its corresponding symbol, so that when the condition is selected in the form, the symbol is automatically stored in the database (Appendix B1). In turn, since the dental chart image is composed entirely by recorded dental symbols, the changes will automatically appear in the form.

Dental Encoder works as a database of missing people. It enables introducing new elements, combining one database with a different sample of individuals from other databases or comparing it with other databases of unidentified corpses. Besides effectively managing dental information, it is also possible to filter the data to, for example, only show individuals who have specific clinical conditions in certain dental pieces, using selection criteria through another electronic form.

Moreover, Dental Encoder allows obtaining a report with the results of the search conducted (Appendix B2). It may also help drawing conclusions based on victim identification reports since the dental symbols present in the dental chart are directly incorporated with the remaining characteristics of the patient.

3.2 Military population

For military forces involved in peace or war missions, human identification may be particularly important. Since military personnel involved in those missions are often exposed to situations of extreme risk, the need for identification is more likely than among the civil population (Bel Blesa, 2011; Sarode *et al.*, 2009). Therefore, specific protocols have been developed to regulate the technical procedures for identifying victims who are members of the Armed Forces. The comparison of dental records of military personnel from different countries may determine if these populations are distinguishable based on their dental characteristics in the context of forensic identification (NATO, 2014a; Real Decreto, 2005).

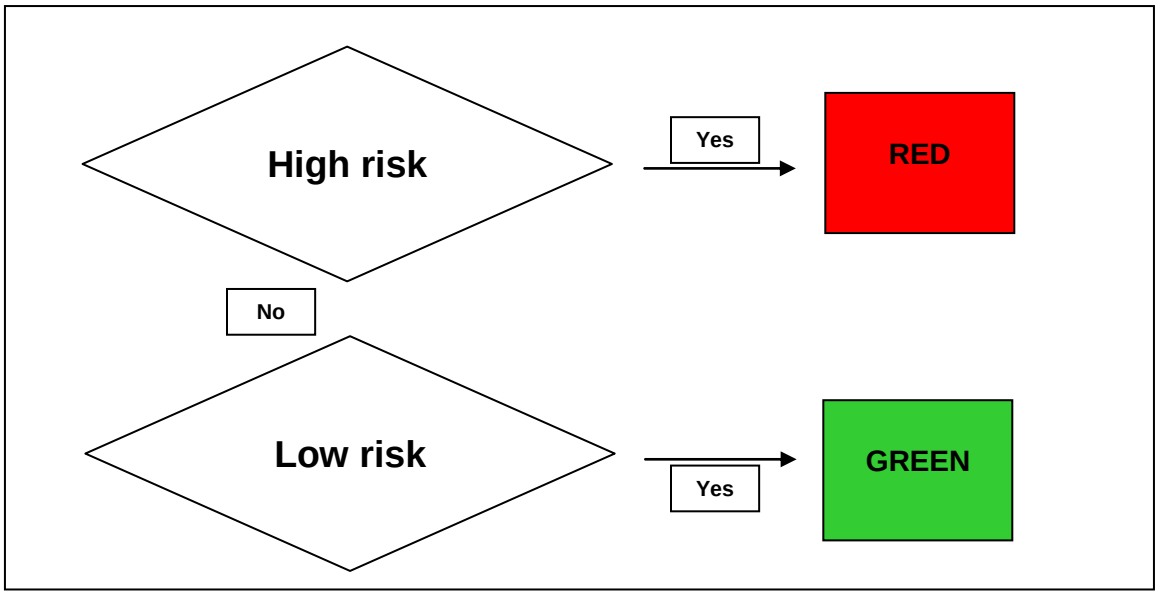
The specific methodology that should be used in the process of dental identification in the military context is still indirect but fully regulated based on a procedure standardization agreement for North Atlantic Treaty Organization (NATO) member countries. That document defines the expert functions of military Dental Medicine in the field of forensic identification (NATOa, 2014), thus establishing a protocol that standardizes procedures and technical and human means.

Before recruitment, military personnel have to fulfill the minimum requirements of oral health, as described in “NATO Guide for Assessing Deployability for Military Personnel with Medical Conditions” (NATO, 2014b). That NATO Guide states that military personnel should fulfill dental fitness classes that represent a low risk, namely, dental fitness class 1: no dental treatment required and no further dental appointments required; or dental fitness class 2: there is an existent dental condition that is unlikely to result in a dental emergency within 12 months. This classification aims to prioritize dental care, minimize the number of emergencies due to dental problems and emphasize the importance of oral health for all military forces, both active and in reserve (Evans *et al.*, 2006). Ideally, only military personnel with dental fitness classes 1 and 2 should be selected, but the detailed definition of each class and the final evaluation differ between countries. Many countries have standard operational politics that include some conditions of class 3 as acceptable. Others do not require a strict classification by the clinical personnel for risk evaluation, and, when in doubt, the highest classification is considered (Madika and Van Wyk, 2013).

The dental examination to determine military personnel's dental fitness should also be conducted when they are selected for missions, and dental records should be filled according to the form established by the health entity that conducts the evaluation.

The dental fitness of military personnel is assessed and determined by dentists in a military base during dental appointments, which occur periodically, before missions, in cases of emergency or for specific treatments. The dental fitness is considered as acceptable for every military personnel when it is not expected that their oral care will need assistance or unlikely treatments in the following 12 months (Bel Blesa, 2011).

According to the same guide, dental fitness class 3 is attributed when there is a dental condition that will probably cause a dental emergency within 12 months or that is currently under care but will likely result in an emergency situation if the treatment is not concluded. Dental fitness class 4 is considered in military personnel who need an annual examination, have an undetermined dental status, have no dental records or have an incomplete dental record. These dental fitness classes represent a high risk, and military personnel classified with them should not be selected.



Legend: Dental Fitness - according to NATO.

The risk of conflict and post-conflict lesions among the military personnel have been highly discussed for a long time regarding mortality and morbidity concerns, and this includes information on the different types of offenders (criminals, demonstrators or terrorists) (Knapik *et al.*, 2009).

Military health risks were associated with post-conflict lesions and related morbidity, such as: mental health disorders, traumatic brain injuries, suicide, rheumatological injuries, increased risk of cancer, and alcohol and drug dependence (Bergman, 2017; Printz, 2015; Sharkey and Abraham, 2015; Bogers *et al.*, 2013, Gubata *et al.*, 2013, Hill *et al.*, 2013, Smith and Coetzee, 2013). The risks of conflict include: military trauma, spinal injuries, acute pain, physical and sexual abuse,

pandemic diseases and, in some cases, death (Jeffery *et al.*, 2013; Aldington, 2012; Connor *et al.*, 2012; Possley *et al.*, 2012; Thorson *et al.*, 2012).

Military personnel are often exposed to adverse environments. Occasionally, their identification is only possible based on their teeth. As explained above, Forensic Odontology allows comparing AM and PM dental records and provides one of the best ways for establishing an individual identification, sometimes being the only method for identification or exclusion (Kieser, 2006; Tan P-H, 2005; Pretty and Sweet, 2001).

Due to their exposure to these several types of danger, the military personnel have a higher likelihood of needing identification. When AM dental records are carefully prepared, human identification can be successful, even if other elements are missing. Furthermore, the cost-benefit relationship is highly favorable when dental identification is available. Human identification based on previous dental records has proven to be extremely useful, particularly in mass catastrophes or even in extreme situations, such as wars, earthquakes, aircraft accidents or shipwrecks (Thorson *et al.*, 2012).

Chapter II. – Objectives and Work Plan

With the aim of providing better understanding and improving the currently existent procedures for dental identification, the following general objectives were proposed:

First: To understand the global commitment regarding the organization and storage of dental records and compare it with the safety risk of each country. To understand the frequency of the several dental clinical conditions in a small sample of the population and, thus, contribute with information on the dental diversity of the Portuguese military population.

Second: To build a dental database of a Portuguese military population to study and analyze the diversity of dental patterns and dental characteristics of a large sample of the Portuguese military population. To determine, based on the collected data, the frequency and distribution of different conditions/pathologies found in each dental piece. To use those data in statistical models to determine the certainty degree of the identification of an individual based on their dental condition.

Third: To compare the diversity of dental characteristics between the Portuguese and Spanish military populations. To determine the differences and similarities between these two populations in order to identify dental characteristics useful in forensic analysis for human identification.

The **Work plan** was the following**:**

1. We emailed a questionnaire about the organization and storage of dental records and the related awareness by dentists to organizations that represent Dental Medicine in the five continents, whose email addresses were obtained in the FDI official website. We determined the risk classification of the countries based on the "International SOS" rating, which is provided to travelers and is divided into extreme, high, moderate, low and insignificant risk.

We collected and analyzed a small dental database of a Portuguese military population that allowed analyzing the frequencies of the several dental clinical conditions and assessing the diversity of the several dental patterns in that population. We analyzed the dental data using a generic codification that groups similar clinical

conditions, to reduce the possibility of the dentist providing insufficient or little-detailed information.

2. We collected and analyzed a large dental database of a sample of the Portuguese military population that allowed analyzing the frequencies of the several dental clinical conditions and assessing the diversity of the several dental patterns in that population. We also used the generic codification for this purpose.

3. We collected, using the generic codification, and analyzed a large dental database that included samples of the Portuguese and Spanish military populations, to determine differences and similarities between these two populations, so as to identify dental characteristics that would be useful in forensic analysis for human identification.

Chapter III. Materials and Methods

1. Research project

This research project entitled “The contribution of the study of diversity and dental treatment and its utility in forensic identification”, which originated the present thesis, was approved by the Ethics Committee of the D. Pedro V Military Hospital, Porto, Portugal (Appendix A), as well as by the Spanish Ministry of Defense in the collection and treatment of the Spanish sample data.

The elements from the Portuguese population were collected in the Stomatology Service of the D. Pedro V Military Hospital, Porto, Portugal, by Maria Inês Guimarães, dentist and author of the present Doctoral Thesis. The Spanish sample's codified dental records were obtained from Personal Health Identification Records collected in the Health Services of different military barracks at the Spanish municipalities of Almeria, Granada, Córdoba, Málaga, Seville, Alicante, Murcia and Ciudad Real, by Jesús Martínez Chicón, dentist and Official of the Military Health Corps.

Both studies were conducted in compliance with the Personal Data Protection Law, according to the international recommendations by the World Medical Association on clinical research, as gathered in the Helsinki Declaration.

In this study, the dental pieces are designated according to the numeration established by the FDI, to facilitate the presentation, comprehension and visualization of the obtained data (Keiser-Nielsen, 1971). The dental clinical characteristics were recorded in their corresponding dental charts using the Forensic Dental Symbols® system (Appendix B). They were then treated and analyzed using the Dental Encoder® database (Martínez-Chicón, 2013; Martínez-Chicón, 2012; Martínez-Chicón, 2008), which is designed and adapted to the dental forms of the Disaster Victim Identification proposed by Interpol (INTERPOL, 2014), as well as the Microsoft® Office Excel and SPSS version 23.0 software.

2. Inclusion and exclusion criteria

In this project, the first inclusion criterium was military personnel who had had their last dental appointment in the D. Pedro V Military Hospital between January 2010 and July 2013. Other inclusion criteria were complete and legible dental records and individuals aged between 18 and 63 years old, even though the maximum age in mission is 49 years.

The exclusion criteria were non-military personnel who had conducted dental appointments during the established period, incomplete or illegible dental records, dental records lacking characterization elements such as age and sex, and individuals aged below 18 years or above 63 years.

3. Study Population and Sample

At the beginning of this research, we conducted a questionnaire on the awareness of the dental care provider regarding the organization and storage of dental records throughout the world. For this purpose, we obtained the emails of the FDI dental organization of each of the five continents from the FDI website and emailed them the questionnaire (FDI, 2015). To consider the risk classification of the countries, we used the “International SOS” rating, which is provided to travelers and rates a country's risk as extreme, high, moderate, low and insignificant (International, 2015).

Afterwards, we conducted a pre-study on 595 Portuguese military workers of the Portuguese Armed Forces, whose last dental appointment/treatment had been conducted between January 2010 and July 2011, at the Stomatology Service of the Pedro V Military Hospital, Porto, Portugal, after obtaining approval by the competent authorities (Appendix A). We then increased the sample size and conducted a retrospective study based on a sample of 1636 Portuguese military workers of the Portuguese Armed Forces.

Between 2006 and 2008, the dental records of a total of 3920 individuals from the Spanish military population who had participated in international missions had been computerized for posterior study. We used that sample in our study.

Thus, we studied a total sample of 5136 individuals from the professional military corps of the Portuguese and Spanish Armed Forces.

4. Materials

We chose the generic codification as the codification system because it groups similar clinical conditions into the same category so that the results can be analyzed from more limited data. Because it is more limited, many common errors intrinsic to the observer tend to be corrected, such as failure to specify the treated surfaces or the type of material used. We analyzed the dental characteristics using a dental codification system that had been applied in a previous study (Blazevic, 2011) and that classifies those characteristics as one of four types:

1. Unrestored - includes healthy teeth, decayed teeth (regardless of the involved surfaces), root fragments, fissure sealants and partially erupted teeth;

2. Restored - includes teeth that were restored, regardless of the involved surfaces or material used;

3. Missing - includes clinical conditions of missing dental pieces, unerupted teeth, dental agenesis and crowns for removable prostheses;

4. Crown - includes teeth with crowns, bridge abutments, pontics for fixed prostheses and implant crowns.

Based on this generic codification, we grouped similar clinical conditions into the same category. For example, every restoration and every missing tooth were grouped together. This summarized codification system limits and corrects potential interpretation differences between observers associated with the correct delimitation of the restored surfaces, the types of material used, the reason for missing roots (exodontia or not), the distinction between abutments and pontics of fixed prostheses, among others. Furthermore, this system simulates the process of dental data collection by forensic odontologists in big catastrophes (INTERPOL, 2014).

5. Methods

For the statistical inferences, we first conducted a Kolmogorov-Smirnov test for each variable to assess the normality of the distribution, and the results did not confirm a normal distribution. When the distribution is not normal, it is recommended using nonparametric tests, but if the sample is large, the normality of the distribution may be considered. In this study, we used two types of tests: the analysis of variance (ANOVA) and the Student's *t*-test for independent samples as parametric tests, and the Kruskal-Wallis test and the Mann-Whitney test as the corresponding nonparametric tests. The conclusion was the same for all cases. We conducted every test considering a 95% confidence level, which implies a consequent p-value lower than 5% to reject the null hypothesis.

We used a 95% confidence interval in every statistical model applied in the analyses and statistical inferences. Due to the sample size (5136), we used parametric tests for the ordinal variable (age group) and nonparametric tests for the categorical variables.

Chapter IV. Thesis Structure

Section I

CLINICAL RECORD OF INDIVIDUAL DENTAL CHARACTERISTICS

- CREATION, VALIDATION AND PRACTICAL APPLICATION -

PROPOSTA DE UMA FICHA DENTÁRIA

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http://www.inedia.net/downloads/omd_6.pdf.

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Resumo

A identificação através da arcada dentária é muito útil, principalmente quando se trata de corpos carbonizados ou esqueletizados. No entanto, para isso ocorrer é necessário dispor de uma ficha dentária anterior (odontograma) fornecida pelo médico dentista da vítima e esse registo é peça basilar para a identificação humana, não só de desconhecidos como de vítimas de catástrofes de qualquer espécie.

O correcto e perfeito preenchimento completo da ficha dentária, no dia-a-dia do médico dentista e/ou médico estomatologista, permite em caso de identificação médico-legal, comparar características *ante-mortem*, existentes nessas mesmas fichas dentárias, com características *post-mortem* para assim obter uma identificação positiva, ou excluir qualquer tipo de possibilidade de identificação. A presença de erros/falhas no correcto preenchimento dos

registos clínicos assim como, na conservação desses dados tem implicações directas nos resultados relacionados com a identificação humana.

Neste trabalho efectuou-se uma proposta de ficha dentária tipo, com informação útil no caso de identificação humana, dando a conhecer as características intra e extra-orais mais importantes que devem constar desses mesmos registos diários, e avaliou-se a importância do estudo das arcadas dentárias como método de identificação humana em situações de grandes catástrofes.

Abstract

The identification through dental records is very useful, especially in carbonized and mutilated bodies. However, for this occurs it's need an dental diagram (odontogram) provided by the dentist of the victim and that registration is basilar for human identification, not only to strangers but also to victims of any kind of disasters.

The proper and perfect complete dental records, day-to-day medical from the dentist, it's important to compared ante-mortem features, existing in those dental records with post- mortem features, to thus obtain a positive identification, or exclude any possibility of identification. The presence of flaws in the medical records as well as the conservation of these data has direct implications for results related to human identification.

This work was carried out as a proposal for dental records, with information useful for human identification such as intra and extra-oral characteristics within daily records and assesses the importance of the study of the arcades tooth as a method of human identification in cases of mayor disasters.

Palavras-chave

Medicina dentária forense; odontologia forense; ficha dentária; registos *ante-mortem* e *post-mortem*.

Keywords.

Forensic odontology; dental record; *ante-mortem* and *post-mortem* records.

Introdução

Com o desenvolvimento urbano, sente-se a necessidade de apoiar e melhorar a tecnologia, como método de identificação, incluindo a odontologia forense (OD), também designada como medicina dentária forense (MDF) em Portugal. Foram vários os países que mais se desenvolveram nesta área, entre eles, destacamos a Dinamarca, Noruega, Espanha, Estados Unidos da América, México e Cuba.

A realização de um registo dentário eficaz é um passo importante na gestão eficiente da saúde oral dos doentes e na maximização do acto médico dentário, pois permite arquivar conjuntamente os processos administrativo e clínico, exames complementares de diagnóstico, fotografias e assim providenciar informações às autoridades legais, no caso de ser necessário identificar um indivíduo, seu doente, além da partilha com outros profissionais de saúde.

A realização de uma ficha dentária tipo, tem como primeira grande vantagem a possibilidade de se obter uma identificação positiva, na ausência de dados identificadores tradicionais, tais como, roupa, adornos e jóias, documentos, entre outros, assim como a não necessidade de utilizar exames mais complexos, morosos e dispendiosos, como é o do Ácido Desoxirribonucleico (ADN).

A implementação de um sistema comum aos médicos dentistas (MD) e/ou médicos estomatologistas (ME), de fácil aplicação e utilização, que pudesse ser posto em prática sempre que solicitado, através de uma ficha dentária, representa uma mais valia para situações de identificação humana através das estruturas dentárias.

Pretende-se conceber e discutir uma ficha dentária universal útil para a uniformização dos dados e com importância para a identificação humana em situações de grandes catástrofes.

Métodos

Foi realizada uma pesquisa bibliográfica efectuada na B-on, Pubmed e Science direct, durante o período de 30 de Maio de 2007 e 09 de Abril de 2009.

Corpo da revisão

Tratamento e uso dos registos dentários

Os registos dentários são um importante auxiliar para o reconhecimento de pessoas vítimas de catástrofes em que não se pode contar com outros meios de reconhecimento, como também, para o MD e/ou ME, quando chamado a colaborar com a justiça, pois assim pode apresentar esse documento que será confrontado com as condições orais encontradas em restos cadavéricos, submetidos a processos de identificação.[1,2] O Dr. Óscar Amoedo, considerado o impulsionador da MDF, que interveio com êxito na identificação mediante o estudo das arcadas dentárias em quarenta cadáveres de vítimas de um incêndio ocorrido no Bazar da Caridade de Paris, em que faleceram 126 pessoas, apresentou num congresso médico internacional no ano de 1897, a necessidade de estabelecer um sistema internacional único de anotação dentária e uma só nomenclatura.[3]

Clark (1994) analisou a contribuição dada pela OD em dez catástrofes ocorridas em território britânico, indicando as dificuldades associadas com a aplicação de métodos de identificação, principalmente no que diz respeito às falhas no preenchimento dos registos dentários, sugerindo que através da Federação Dentária Internacional (FDI) cada país membro tome conhecimento sobre o correcto preenchimento dos registos, e divulgue estas informações dentro do seu país, pois qualquer cidadão de qualquer nação pode ser vítima de desastres internacionais. Verificou que 55% de cadáveres foram identificados através de comparações das arcadas dentárias, nessas dez catástrofes ocorridas em território britânico.[4-5] No entanto, numa das catástrofes apenas 6,24% das vítimas puderam ser identificadas pela comparação com radiografias dentárias. Um elevado número de dificuldades associadas a este método de identificação foi consistentemente encontrado.[6]

Alguns dos problemas que os médicos dentistas forenses tiveram que enfrentar foi a falha, por parte dos profissionais de saúde, na manutenção de registos compreensíveis[6,7] e a prevalência de erros nos registos dentários, avaliados em mais de 45% numa amostra de 50 registos. Para além disso, existiam muitos indivíduos que nunca tinham recebido tratamento dentário, o que impossibilitou o acesso a registos *ante-mortem* (AM).

Essas inconsistências podem ser compatíveis ou incompatíveis.[7] A inconsistência compatível é aquela em que a diferença encontrada pode ser logicamente explicável e não prejudica a identificação (p. ex: execução do tratamento, após o registo já estar efectuado). A inconsistência incompatível corresponde aos erros de registo no odontograma, como por exemplo, a ausência de uma restauração efectuada. A maioria ocorre na região pré-molar e

molar e resulta frequentemente da extracção prévia de uma peça dentária por outro dentista, seguida de perda de espaço mesio-distal.

Foram também referenciadas dificuldades na utilização de registos dentários AM devido à dificuldade na leitura da letra do profissional, e ainda, a falhas como a utilização de abreviaturas, erros no registo do material utilizado, na face e no registo do próprio dente em que se efectuaram os tratamentos.

É bastante frequente que o médico dentista forense tenha que preparar um odontograma AM utilizando a mistura de vários registos, notas clínicas e radiografias existentes[7] antes de iniciar a comparação de dados AM e *post-mortem* (PM). As mudanças nos tratamentos dentários e hábitos profissionais e pessoais, estão a alterar a utilização de características dentárias particulares para a identificação humana.

O impacto destas mudanças levanta problemas relacionados com a fiabilidade e com a exactidão deste método para a identificação:[8-10]

- o melhoramento dos cuidados de saúde oral, resulta na realização de restaurações dentárias em menor número e com menor complexidade; isto pode levar a que uma das principais características para a identificação humana seja eliminada;

- assim como o uso crescente de selantes de fissuras e outras restaurações com resina composta, que nem sempre são visíveis nas radiografias, tem como resultado, que as características disponíveis para identificação cruzada ficam reduzidas;

- as preocupações com o custo e segurança causaram uma diminuição na quantidade e na frequência de realização de radiografas dentárias de rotina; isto tem como efeito um menor número de registos dentários AM disponíveis para comparação PM.[11-13]

Dada a importância que os registos dentários fiáveis têm para o sucesso da identificação humana[14], efectuou-se uma proposta de ficha dentária que permita melhorar a qualidade na actualização e na recolha de dados.

A uniformização das fichas dentárias e a potenciação de utilização de suporte digital permitirá colmatar omissões que surgem devido à falta de regulamentação sobre o conteúdo das fichas dentárias. Nomeadamente, o não registo de tratamentos anteriores e efectuados, erros na identificação do dente/quadrante, de não existirem actualizações e anotações relativas a diversas particularidades, e ainda o facto de cada MD e/ou ME desenhar a sua própria ficha

dentária.[15] Sugere-se que se elabore uma listagem, com um conjunto de características que deveriam constar de uma ficha dentária, com interesse para a identificação humana.

Nos itens seguintes identificam-se as várias partes que propomos para o preenchimento da ficha dentária tipo.

Identificação e anamnese

Visando o desenvolvimento de um trabalho dentário adequado, é necessário ter noções sobre a saúde geral do doente, pois esta informação nunca deve ser dissociada da saúde oral, e desta conjugação é esperado um bom tratamento/diagnóstico.

Para contornar eventuais problemas que possam surgir, é necessária a aplicação de um questionário, que deverá ser respondido e preenchido pelo próprio doente e que, posteriormente, será aprofundado pelo MD e ME (não esquecendo que o doente ou o responsável legal devem assinar o documento).

Exame extra e intra-oral

Na ficha dentária tipo devem ser registadas características extra-orais, assim como características intra-orais.

Do exame extra-oral devem ser registadas características tais como, tipo de fácies, assimetrias, problemas na ATM, sinais congénitos (cicatrizes), a existência de “piercing” na face, nomeadamente, nos lábios, nariz e sobrolho, a presença de gânglios linfáticos tumefactos, edemas, entre outros.

Do exame intra-oral devem ser registadas alterações ao nível dos tecidos moles, existência ou não de anomalias dentárias, hábitos parafuncionais e estigmas profissionais, assim como, a utilização de próteses dentárias removíveis ou fixas, o tipo de oclusão e a presença de outro tipo de dispositivos orais, como aparelhos fixos e removíveis, presença de goteira oclusal, entre outros.

Nos tecidos moles, devemos ter atenção aos tecidos de suporte dentário (periodonto), ao vestíbulo, à gengiva e à língua, pois estes podem apresentar sinais individualizadores. No entanto, são de menor valor para a identificação humana, pois destroem-se mais facilmente, como por exemplo, no caso de corpos carbonizados. Apesar disso é importante verificar a morfologia, a cor e o contorno da gengiva, a presença de sinais particulares, como manchas ou tatuagens e o estado periodontal, nomeadamente a higiene oral, presença ou ausência de gengivite e/ou de doença periodontal.

Relativamente às anomalias dentárias, estas encontram-se associadas a defeitos do desenvolvimento dos dentes e podem ter origem hereditária, congénita, traumática ou ambiental, generalizada ou localizada, devendo os MD e/ou ME estar atento às alterações de número, forma, dimensão, posição, estrutura e cor.

Esta informação pode ser directa e identificar por si só a pessoa, como também pode ter valor indirecto, quando se pretendem estudar as marcas deixadas, por exemplo, numa mordedura de uma perna ou numa peça de fruta, no caso de violência familiar, ou num assalto.

De seguida, propomos uma nomenclatura clara e sintética, para o preenchimento do odontograma, no que diz respeito à utilização de próteses removíveis.

Assim:

- T/– quando se tratar apenas de uma prótese total superior e não existir nenhuma prótese inferior .

- –/T quando se tratar de apenas uma prótese total inferior e não existir nenhuma prótese superior.

- T/T quando se tratar de uma prótese total superior e de uma prótese total inferior.

O mesmo sucede para as próteses parciais removíveis:

- P/–.quando se tratar apenas de uma prótese parcial superior e não existir nenhuma prótese inferior.

- –/P quando se tratar de apenas uma prótese parcial inferior e não existir nenhuma prótese superior.

- P/P quando se tratar de uma prótese parcial superior e de uma prótese parcial inferior.

Relativamente ao material utilizado nas próteses removíveis atribui-se também uma legenda própria, utilizando-se o dígito 1 para as próteses acrílicas e o dígito 2 para as próteses esqueléticas.

Assim, quando se tratar de um indivíduo que tenha uma prótese total acrílica superior e uma prótese parcial esquelética inferior a legenda será T1/P2.

Exame dentário anterior

A ficha dentária do doente deve conter dois odontogramas.[16] No primeiro constará o estado anterior das peças dentárias do indivíduo, antes de qualquer actuação por parte do profissional que o examina e no segundo o registo dos tratamentos realizados a partir desse momento. Isso deixará bem claro quais os tratamentos que o doente já apresentava antes do MD e/ou ME iniciar os seus.[17-17]

Assim propõem-se a seguinte codificação:

0 - Dente são – todas as peças dentárias sãs e dentes com fissuras.

1 - Dente cariado – dentes cariados, independentemente da face afectada, assim como a presença de restos radiculares.

2 – Dente restaurado – peças dentárias restauradas (obturadas), qualquer que seja o material utilizado, e a superfície afectada, assim como a colocação de selante de fissuras.

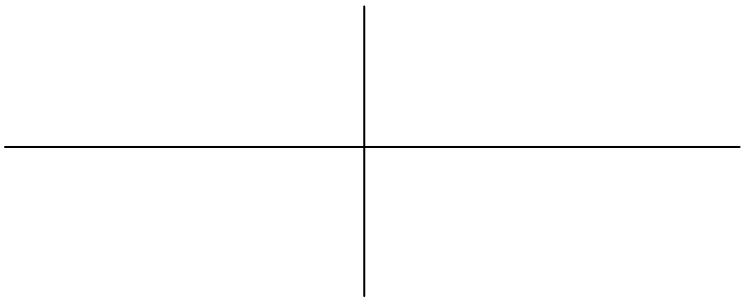
3 – Dente ausente – dentes perdidos por qualquer motivo e dentes não erupcionados e dentes parcialmente erupcionados, observados através da exploração visual.

4 – Dente com prótese fixa – peças dentárias portadoras de uma prótese fixa unitária ou de um pilar.

PR – Portador de prótese removível – existência de prótese removível em zonas edêntulas.

I – Existência de implante – existência de implantes em zonas edêntulas.

Para um completo registo das características dentárias sentiu-se necessidade de criar um espaço na ficha dentária para pormenorizar os tratamentos existentes na cavidade oral, anteriores aos tratamentos realizados pelo profissional, nomeadamente sobre o tipo de material existente em cada peça dentária, em que dente está colocado o gancho de uma prótese removível. Este tipo de informação permite individualizar traços particulares de cada indivíduo.



Este esquema foi concebido por Derek H. Clark, médico dentista inglês especialista em MDF, que desenvolveu a sua tese de doutoramento sob o tema “Post mortem dental identification in mass disaster”, na Universidade de Londres. Este esquema é similar ao utilizado pela “*International Criminal Police Organization*” (INTERPOL), apenas a informação irá ser colocada de outra forma. Já foi utilizado e testado em situações de grandes catástrofes com sucesso.[19,20-22]

Sistema de classificação dentária utilizado pela INTERPOL

Das mais de 35 classificações dentárias existentes em todo o mundo, o sistema de classificação dentária binumérico, definido pela FDI, é o mais aceite pelos MD e/ou ME, no nosso País.

No congresso da FDI, em Budapeste, em 1971, o sistema binumérico foi internacionalmente adoptado e subsequentemente aceite por várias organizações, nomeadamente pela *American Dental Association* (ADA) e pela Organização Mundial de Saúde (OMS), o que representou um grande passo para a comunicação internacional. É também este o sistema de anotação dentária utilizado pela INTERPOL.[21,22]

Na classificação dentária conhecida como FDI, sistema binumérico ou sistema de dois dígitos, o primeiro dígito regista a hemiarcada correspondente e o segundo dígito regista a peça dentária de 1 a 8, no sentido mesial para distal.

A dentição permanente é classificada por:

11 a 18 no maxilar superior direito; 21 a 28 no maxilar superior esquerdo

41 a 48 no maxilar inferior direito; 31 a 38 no maxilar inferior esquerdo

A dentição temporária é classificada por:

51 a 55 no maxilar superior direito; 61 a 65 no maxilar superior esquerdo

81 a 85 no maxilar inferior direito; 71 a 75 no maxilar inferior esquerdo

No entanto o tempo despendido na anamnese, pelos MD e/ou ME, terá que ser suficiente para o preenchimento de todos os campos de uma ficha dentária completa.

Por essa razão, propomos acções de sensibilização e alertas dentro da comunidade médico-dentária, fundamentando as vantagens de se obterem registos dentários diários completos e actualizados assim como a divulgação entre os MD e/ou ME de questões relacionadas com a justiça para as quais muitas vezes os profissionais não estão devidamente esclarecidos.

Plano de tratamento/exames complementares

Para melhor planeamento da consulta de medicina dentária, criaram-se dois quadros na ficha dentária tipo. Um, em que se deve registar o plano de tratamento, e outro onde devem ficar registados todos os exames complementares de diagnóstico dos doentes.

Tratamentos efectuados

Nesta ficha dentária tipo foram criados espaços próprios para escrever, de forma clara, o dia da consulta, o tratamento efectuado, a assinatura do doente e a assinatura do médico que realizou o acto clínico.

Conclusões

A Medicina dentária forense constitui um método relevante para a identificação de cadáveres e restos humanos, tanto em casos individuais como em situações de grandes catástrofes. O potencial identificativo da técnica odontológica tem sido amplamente demonstrado ao longo da história da humanidade.

Não obstante, a falta de regulamentação no que diz respeito à informação que se deve obter e conservar nos consultórios médicos, fazem com que em determinadas ocasiões, as informações dentárias obtidas *post-mortem* não possam ser comparadas com os dados *ante-mortem*, por falta de registos, devido ao facto de cada um utilizar a sua própria nomenclatura, assim como, a não actualização dos dados e o não registo de sinais característicos de cada paciente.

Com esta proposta pretendeu-se criar uma ficha dentária tipo, destinada à prática do dia-a-dia clínico na qual se regista toda a informação relevante do doente para acompanhamento da sua saúde geral e oral e que permita a identificação médico-legal em caso de necessidade.

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Professora Doutora Rita Gaio, pela sua preciosa ajuda no desenvolvimento deste trabalho.

Ficha dentária

Registo nº

1. Identificação

Nome	
Data Nascimento	
Morada	Sexo
Profissão	Nacionalidade
Número beneficiário	Entidade Resp.

2. Anamnese

Motivo da Consulta	História Clínica
Antecedentes pessoais	Hospitalizações
Tratamentos Actuais / Medicação	
Apresenta hemorragias frequentes / Tratamento anticoagulante?	
Alergias	Doenças Infecto-contagiosas
Consumo drogas abuso/álcool	Fumador nº cigarros/dia

3. Exame extra-oral

Marcas de nascimento		Fácies		Cicatrizes		Tumefacções		Piercing	
Gânglios linfáticos		Edemas		Assimetrias		ATM		Outro	
Sinais particulares									

4. Exame intra-oral

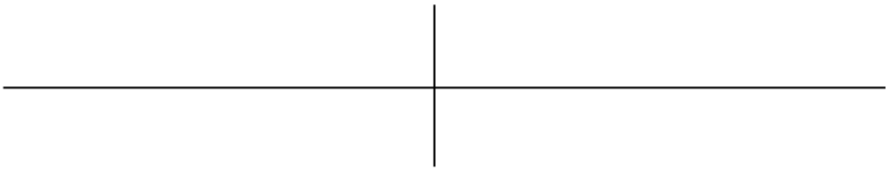
Alteração dos tec. moles		Anomalias dentárias		Hábitos parafuncionais	
Morf. da gengiva (cor, contorno)		Número (agenesia; supranumerário)		Estigmas profissionais	
Presença marcas individ. (manchas ou tatuagem)		Forma		Bruxismo	
Estado period. (Hig.oral, geng, dça periodontal)		Tamanho		Roedores de unhas / Canetas	
		Posição (diastemas, apinhamentos)		Fumadores de cachimbo	
		Estrutura e cor (atricção, fluorose)		Outro	
		Outro			

Uso de prótese				Oclusão		Presença de dispositivos	
Total		Parcial		Mordida cruzada		Presença de goteira	
Superior		Inferior		Topo a topo		Presença aparelho removível	
Acrílica		Esquelética		Mordida aberta		Presença aparelho fixo	
				Alt. sentido sagital (I, II, III)		Presença piercing	
Fixa							
Implante							

Códigos
0 Dente são
1 Dente cariado
2 Dente restaurado
3 Dente ausente
4 Dente com prótese fixa
PR Portador de prótese removível
I Portador de implante

5. Exame dentário anterior

			55	54	53	52	51	61	62	63	64	65			
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
			85	84	83	82	81	71	72	73	74	75			



6. Plano de tratamento

SD																SE
ID																IE

SD – superior direito; SE – superior esquerdo; ID – inferior direito; IE – inferior esquerdo

7. Exames complementares

Data	Tipo	Resultado

8. Tratamentos efectuados

			55	54	53	52	51	61	62	63	64	65			
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
			85	84	83	82	81	71	72	73	74	75			

9. Trabalhos Efectuados

Data	Trabalho Realizado	Ass. Paciente	Ass. Médico

DENTAL RECORD PROPOSAL USEFUL FOR HUMAN IDENTIFICATION IN MASS DISASTERS

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Abstract:

Forensic odontology has been actively contributing for legal medicine through human identification, mainly in limit situations, such as mass disasters with highly destructed, carbonized and mutilated bodies or in advanced decomposition or, generally, in situations in which the mortal event is incompatible with conventional approaches. In these settings, comparison between dental events of examined post-mortem human remains, and odontogram of suspected victim ante-mortem is required for a complete identification.

Keywords:

Forensic odontology, ante-mortem and post-mortem records, dental identification, odontogram

Introduction:

Forensic odontology emerged and had considerable visibility improvement after some accidents that required identification techniques for victims in extreme situations(1-3). Teeth anatomic comparison with previous available records is one of most important alternatives for human identification(3,4). Resistance of dental arches, due to its physical, chemical and

biological characteristics, make them an anatomical element available in cases of severe aggression.

Although dental identification is not an innovative methodology, its usage has development potential in order to achieve more efficient and reliable results.

Objective:

The aim of this work is to elaborate a dental record form able to summarize all current dental data, useful in case individual identification is required.

Methods:

Bibliographical research in Pubmed and Science direct, using keywords “dental records”.

Discussion:

Major disasters are specific situations where techniques of forensic identification have significant practical application(5,6).

Following França(7), identification by dental records is very important, especially when it comes to charred or skeletonized. Therefore, it is necessary to have previous dental records provided by odontologists of the victim. Qualified odontogram available is key in order to identify unknown disaster victims.

Thus, by comparing dental records with current dental situation of body and signs still preserved in dentition, it is possible to reach a positive identification.

The main points of comparison are(8-10):

- Position of each tooth and its characteristics;
- Existence of cavities and their precise location;
- Absence of one or several dental pieces;
- Presence of root fragments;
- Existence of removable dentures, fixed or other dispositive;
- Details of each restoration, and material used.

Regarding each tooth characteristics is important to highlight its condition concerning color, etching, cleaning, existence of malformations and tooth type (temporary or permanent), and knowledge of normal anatomical properties of human teeth, macro and microscopic. All these figures are quite relevant to dentistry expert (11,12).

All these features are important when examining a tooth, check out whether is a human or animal tooth, deciduous or permanent, and then determine what group they belong to (incisors, canines, premolars and molars).

Available radiographies are another important data source to be compared with body remains(7). Most commonly used are orthopantomography, skull, face, and long bones radiographies(13-16). Among these, panoramic radiography has special relevance for human identification, because can also be used to collect data concerning frontal sinuses, jaws, temporomandibular joint. Other important references are presence of edentulous spaces(17), malformations and malocclusions.

There are other valuable data, quite relevant in human identification, like tooth loss, fractures, wear, fouling and lesions produced by mechanical agents(18).

Data collected and recorded by odontologist is key for successful human identification, namely by precise patient data, including previous teeth situation and oral cavity, as well as all executed treatments. However, there are several constraints that limit dental records usage, such as:

- classification systems harmonization gap;
- odontologist own dental record form format;
- mutability of dental specimens over time by natural processes, pathological or mechanical;
- maintenance constraints in registration of all dental arch changes, such as present and missing teeth.

Before recent introduction of composite resigns, most materials used in dental restorations belonged to the group of metals and therefore dental radiographs had radiopaque images, therefore unique characteristics of each restoration could be easily observed in standard radiographs. With these new materials introduction and preventive dental care generalization, which led to a positive significant reduction in caries incidence, especially in

developed countries, standard radiographic technique loss some effectiveness in identification process.

According to Ramos and Calvielli, referenced by Silva(11,12), previous dental situation, after odontologist treatments is not possible to be proof, unless by the complete record from a professional, as well as all follow-up subsequent documentation collected. This is a unique opportunity to have an evidence, which have no other chance to do it correctly.

During World Dental Federation (FDI) congress in Budapest in 1971, was adopted internationally two-digit notation and subsequently accepted by various organizations, including American Dental Association and World Health Organization, which represented a milestone towards international communication. This is also dental annotation system used by INTERPOL "International Criminal Police Organization(19-21).

Conclusion:

Motivations for victims identification in mass disasters can be multiple and have different sources, such as religious, ethical, legal or other responsibilities, not only personnal but also criminal.

Human dentition individuality has been recognized for many years. Its main advantage is related to the fact that teeth are the last part of the human body to be destroyed and can remain more or less intact for many years after death. Moreover, due to its stability from a biological standpoint, and because during their development, certain habits and certain diseases can affect the dental tissues, they contain information such as brands that are unique and timeless.

Therapeutic activity of odontologists, including execution of restorations and prostheses, prescription of certain drugs may have significant teeth impact. Due to this reason, it is possible to evaluate full records importance in situations of human identification.

Comparison of ante-mortem (AM) and post-mortem (PM) data may lead us to one of the following situations:

- Positive identification: there is a singularity data comparison between AM and PM, and there are not significant differences;
- Identify suspected (possible): there are similarities between the AM and PM data, however, may be lacking sufficient information to establish a positive identification;
- Insufficient evidence to identify: there isn't enough evidence to compare and reach to conclusions based on scientific principles;

• Exclusion of evidence for identification: there are discrepancies between the explicable and inexplicable comparison of AM and PM data, resulting in inconsistencies that prevent the establishment of any identification. An exclusion may be as important as determining a positive identification.

This conclusion is very important, not only to reach to a positive identification but also exclude someother.

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ORAL CANCER: HEALTH PROMOTION AND VISUAL SCREENING —A STUDY REPORT

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Abstract

Background. Oral cancer presents a heterogeneous geographic incidence. Annually, more than 275.000 new cases are diagnosed worldwide. Despite the easy accessibility of oral cavity during physical examination, most malignancies are not diagnosed until late stages of disease.

Methods. Oral health promotion was our main objective, risk factors were identified and oral cavity self - examination was promoted. The population considered (n=1117) was divided in two main age groups – a youngest (individuals under 25 years old) mostly targeted for oral cancer awareness and oral cavity self examination promotion – and an older group having accumulated potential risk exposure.

Results. The results obtained revealed smoking habits and fruits-vegetables consumption deficit as the highest risks factors found. Considering a Risk Factor Exposure Index analysis,

individuals with secondary level of instruction and living in sub-urban areas assumed the highest risk exposure. Alcohol consumption had also contributed as a significant risk exposure.

Conclusions. Some of these risk factors work as biological reward of quality of life deficit. A wide comprehension of the problem require a multidisciplinary approach necessarily involving Health and Social Sciences in order to target the core of oral cancer health promotion.

An effective epidemiological strategy must thus support three major aspects: population knowledge, sensitization and visual screening.

Keywords: oral cancer, visual screening, oral health promotion, epidemiological strategies

Background

Oral cancer (OC) presents a heterogeneous geographic incidence and reveals to be more frequent in developing countries. Annually, more than 275.000 new cases are diagnosed worldwide – 64 000 were identified in European Union (EU) in 2004 [1]. Five percent of all tumors occur in head and neck – such cancers are the 6th common form of cancer in the world and 4th in Europe - approximately half of them occur in oral cavity contributing to an overall of 2,8% of all cancers [2,3].

Oral cavity includes lips, tongue, oral mucosa, gums, vestibule, mouth floor and palate (ICD9 C00-C06). The most common localizations are mouth floor, tongue lateral edge and soft palate. The five-year survival rate for OC is around 50-60% [4].

Concerning oral malignancies, squamous cell carcinoma (SCC) contributes with a significant 90% of such malignancies. It has been recently reported that overall incidence and mortality associated with SCC are increasing, with current estimates of gender-standardized incidence and mortality being 6.6/100,000 and 3.1/100,000 in men and 2.9/100,000 and 1.4/100,000 in women, respectively [5].

As most cases are late diagnosed, therapeutics is either ineffective or physiologically quite aggressive and expensive. When surviving is considered, these patients exhibit a reserved prognosis. Basic physiological functions are often impaired and quality of life of these patients is severely affected [4,6,7].

The decreasing mortality rates in EU (about 7%) identified since the beginning of the century are not, unfortunately, a world trend: mortality from OC has been rising in several other regions of the world being young people mainly affected [5,8,9].

Risk factors

Tobacco and alcohol are the main risk factors associated with OC development. Tobacco accounts for the highest share, particularly when non-filter smokers are considered [8,10]. It is estimated that 8 out of 10 patients diagnosed with OC consume tobacco or have consumed it – these patients present an increased 5-7 fold risk of developing OC when compared with non-smokers. More over, the risk of cancer seems to remain elevated many years (at least 10) after smoking cessation [11].

Tobacco and alcohol consumption are associated with approximately 75% of upper aerodigestive tract cancers. Proliferative cells seem to be influenced by alcohol, involving both intracellular (e.g., endocytosis) and intercellular (permeability) pathways [12].

The link of the known risk factors - alcohol and tobacco - with oral microorganisms is recently under investigation. It seems that infectious agents interfere both in tumor genesis and defensive factors by causing inflammation with subsequent release of cytokines and other inflammatory mediators, responsible for some oncogenes activation [13,14].

Periodontal disease has also been shown to increase the OC statistic [15,16].

Fruits and vegetables consumption may constitute a protective factor against OC. According to the American Institute for Cancer Research, nutrients such as vitamins and minerals they contain contribute to keep the body healthy and strengthen immune system [17]. Furthermore, phytochemicals, biologically active compounds found in fruits and vegetables, can help to protect cells from damages that can lead to cancer. The *Mediterranean Diet* has been shown to be associated with reduced OC risk [18-21].

Recent OC molecular biology research has also pointed genetic factors as other important risk factor in oral carcinogenesis predisposition [22].

Oral Cancer: Visual Screening

Despite the general accessibility of oral cavity during physical examination, most malignancies concerning this body part are not diagnosed until late stages of disease.

Despite no clear advantages in OC screening were admitted for decades, several studies point to the obvious advantages associated with visual oral screening [23,24].

Oral Cancer: Health Promotion

Although the increased knowledge and progress made on cancer molecular basis understanding, neither oral cancer incidence nor the 5-year mortality have not decreased in the same proportion [25]. Such facts suggest that challenges remain to explore in OC management: prevention, diagnosis, and surgical and non-surgical treatment. Considering prevention and diagnosis, comprehensive strategies involving the individual at a community level might facilitate integration of the knowledge achievement and population sensitization, needed for decreasing risk factors exposure [26].

Aims

The results of an Oral Health Project for OC prevention are analyzed. Oral health promotion was a main objective of the Project and oral cavity self-examination was promoted. Oral visual screening was performed in order to precociously detect malignant lesions or with malignant transformation potential.

We aimed a further understanding of OC risks factors identified in order to guide more effective future oral health measures.

Methods

Two main age groups were considered – a youngest population (under 25 years old) mostly targeted for oral cancer awareness and oral cavity self-examination promotion – and an older group having an accumulated risk exposure potential. Socio-demographic, risk exposure and some life style data were collected in order to further understand determinants for OC development.

The Otorhinolaringology service from the Portuguese Institute for Oncology – Porto (IPO-Porto, ORL) performed training actions for dentists and dentistry students' finalists. The instructions and guidelines provided aimed to scientifically prepare and calibrate all 8 dentists participants and 30 dentistry students finalists (Dentistry, Msc, Fernando Pessoa University, Porto, Portugal) involved in the screening. Eight work teams were composed with at least 1 dentist and 4 dentistry students.

Each screened individual (n=1117) was invited to fulfill a questionnaire concerning:

- socio-demographic data (gender, age, residency and schooling)
- risk factors exposure (tobacco habits, ethylic habits; solar radiation; risky profession or risk agents familiarity, fruit and vegetables consumption deficit, family history for OC)
- dental health status (oral hygiene; dental prosthesis; parafunctional habits and DMF index - decay/missing/filled). Concerning oral hygiene, daily brushing times and oral hygiene devices were used to classify as “adequate hygiene level” and “poor hygiene level”. It was considered an adequate oral hygiene if: 1) brushing was twice a day and took place in the morning after breakfast and at night before sleeping time and 2) hygiene devices used were at least brush, toothbrush and dental floss.

Previous oral infection (Herpes Virus, Human Papiloma Virus or Candida) was not considered for OC risk rating because there was no access to clinical records.

Work teams accomplished 1117 oral visual screenings and held 40 informative sessions concerning OC awareness. About 30-40 individuals attended each session that lasted for about 20 minutes. A debate moment followed each session and all questions placed were answered.

All participants resided in Oporto district and voluntarily gave their written informed consent.

This visual oral screening study counted on media divulgation (television, radio, journals and internet). Further, 10.000 informative flyers concerning OC prevention and visual screening, were distributed.

A Risk Factor Exposure Index (RFEI) was designed to express the balance between risk factor exposure and protection. RFEI was calculated based on the number of cigarettes smoked per day, adding 1 point for every 5 cigarettes, the number of years of smoking by adding one point for every 5 years, also adding a point (per item) for drinking alcohol, living with smokers, having parafunctional habits, and excessive sun exposure. The value obtained was subtracted 1 point for each daily meal involving fruit consumption. The measurement was expressed as a percentage.

Student t test for independent samples was used to investigate risk factors differences when analyzed according to gender, alcohol consumption, and suspected benign lesion. In order to evaluate the differences for risk factor among age groups, years of schooling and residential area, an analysis of variance was performed. The identification of differences between each class of each group was performed by Bonferroni test.

The Statistical Package Social Sciences (SPSS) version 17 for windows, analyzed the collected data.

Results

All participants (n=1117) fulfilled the questionnaire and the vast majority of questions (only 67 and 2 missing questions were detected concerning being ex-smokers and having maladjusted dental prosthesis, respectively).

Socio-demographic characterization

Major socio-demographic characteristics are depicted in table1.

CHARACTERISTICS		n (%)
Gender		
	male	510 (45,7)
	female	601 (54,3)
Age		
I	Less than 14	614 (55,0)
II	15-24	188 (16,8)
III	25-34	66 (5,9)
IV	35-44	79 (7,1)
V	45-54	64 (5,7)
VI	55-64	32 (2,9)
VII	More than 65	74 (6,6)

Schooling (years)		
	Basic (1-9)	962 (86,1)
	Secondary (10-12)	140 (12,5)
	University (+13)	15 (1,3)
Residential area		
	Urban	427 (38,2)
	Sub-urban	262 (23,5)
	Rural	428 (38,3)

Table 1: Socio-demographic data of the studied population (n=1117).

The studied population included both genders in similar numbers (not significant differences) being the majority young (less than 24 years old). A low academic level was a constant: when considering old enough to conclude any education level, it was found that only 27,8% (140/508) concluded the secondary level and a few 4,6% (15/315) concluded University. Individuals were either from urban, sub-urban or rural locations.

Risk exposure

Major reported risk exposures are depicted in table 2.

RISK EXPOSURE	POSITIVE	NEGATIVE
Smokers	217	900
Ex-smokers	70	980
Severe ethylic habits	78	1039
Solar radiation	239	878
Parafunctional habits	407	710
Maladjusted dental prosthesis	94	1021
Poor oral hygiene	510	607
Risky profession or risk agents familiarity	85	1032
Fruit and vegetables consumption deficit	1083	34
Family history for oral cancer	192	995

Table 2: Oral cancer risk exposure distribution found in the studied population (n=1117)

Most individuals declare to be non-smokers (n=900) and among these 7,8% (n=70) admitted to be ex-smokers. Smoking, revealed thus to be one of the most frequent risk behaviors among all others considered. Figure 1 characterizes the smoking population considering age and gender.

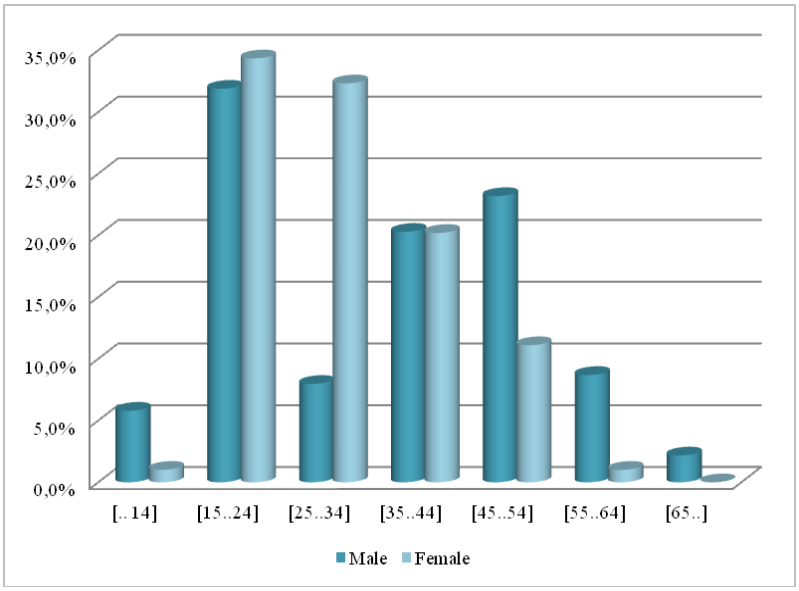

Figure 1 – Smokers percentage distribution considering gender and age.

It was found that youngest group, male individuals (less than 14 years old) smoke significantly more than females. This is indeed the general tendency exception made and inverted when individuals are 25-34 years old. Tobacco consumption revealed to be highest in the 35-54 years old range - later then a decrease is observed, particularly significant in females.

The following figure illustrates daily tobacco exposure (years).

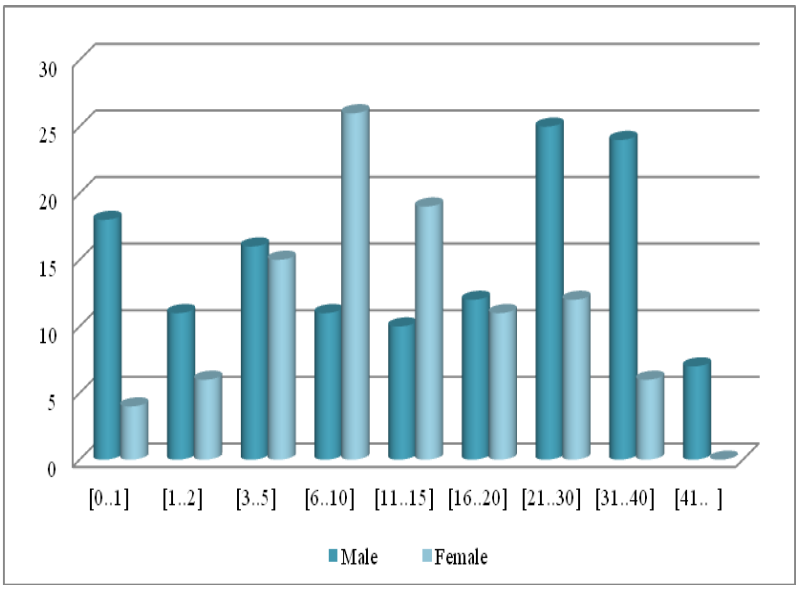

Figure 2: Tobacco exposure (years) considering gender.

It was observed that tobacco exposure presented two main peaks: 6-10 years (n=36, 25 females and 11 males) and 21-30 years (n=34, 11 females and 23 males). For each period range, exposure is mainly masculine, is similar for periods comprising 3-5 years and 16-20 years and is mainly feminine both in 6-10 and 11-15 years of exposure. The period of tobacco exposure that included more females was 6-10 years (n=25).

About thirty eight percent (n=306) of all participants admitted to perform regularly oral self-examination.

The associated Risk Factor Exposure Index (RFEI) found in the studied population is presented in Table 3.

Characteristics		**RFEI (%)**
Gender		
	male	24,6
	female	19,4
Age		
I	Less than 14	15,1
II	15-24	**23,4**
III	25-34	33,4
IV	35-44	34,7
V	45-54	39,4
VI	55-64	28,7
VII	More than 65	15,2

Schooling (years)		
	Basic (1-9)	21,2
	Secondary (10-12)	25,3
	University (+13)	22,8
Residential area		
	Urban	21,3
	Sub-urban	24,5
	Rural	16,7
Alcohol consumption		
	Yes	39,5
	No	20,3
Suspected lesion		
	Yes	24,8
	No	21,8

Benign pathology		
	Yes	24,8
	No	21,8

Table 3: Risk Factor Exposure Index (RFEI) found in the studied population for the socio-demographic variables (gender, age, schooling years and residency), detected suspected lesions or benign pathology (n=1117).

No significant differences were found among genders but when age was considered, several differences were noticed: first, RFEI increases linearly until its peak at age group 45-54 years old and than declines at similar levels to those found in the youngest population; second: the age groups 15-24 years and 55-64 years old assume similar risks being lower than the 25-54 years old individuals; third: 35-54 years old individuals assume the highest risk exposure.

Considering formal education it was found that individual with secondary level assumed the highest risk exposure, significantly different from other education levels (p=0).

It was found that rural individuals presented the lower RFEI that revealed to be significantly different from urban (p=0) and sub-urban (p=0). The highest RFEI was found in sub-urban individuals and was significantly different from urban (p=0,01).

Alcohol consumption (n=78) contributed as a significant higher risk exposure (p=0). Identification of a benign pathology or a suspected lesion, although presented a higher RFEI, differences were not significant – the low number of positive individuals (n=33 and n=15, respectively) most probably contributed to this circumstance.

During oral visual screening 48 individuals were referred for clinical observation because they presented some oral pathology. Twenty-four lesions with malign transformation potential or suspected malignancy were detected (2% from all screened individuals). After further clinical observation all targeted suspicions were then negatively confirmed.

Discussion

We found that an important risk factor such as smoking is already present at young ages (less than 14 years old). Tobacco consumption revealed to be highest in the 15-24 years old range and later after a decrease as a whole is observed (Figure 1). This seems to agree with data found in Portugal by Borges and collaborators [27]. Although the across-the-board agreement with anti-smoking measures, along with hope for a reduced general and individual consumption described no changes were detected in the population studied [28].

Alcohol consumption together with tobacco use has been recognized as an important synergistic risk factor for OC for almost 50 years [29,30]. The heterogeneous population studied might explain the low percentage of severe ethylic habits found. However, when considering only the older group, the percentage of individuals with severe ethylic habits increased significantly.

The low educational level observed and a significant proportion of individual's exposed to tobacco for quite long periods (Figure 2), supports the need of preventive strategies of oral health promotion, particularly focused among the youngest. Knowledge and attitudes about smoking have been described as varying with socio-demographic characteristics such age, education level and residential area [31-34].

The World Health Organization recommends a consumption of at least 400 g per day - five servings per day of fruits and vegetables [38], being known that dietary deficiencies, especially vitamins A/C/E and iron are considered risk factors [35-37]. Moreover Petersen (2009) showed that heavy intake of alcoholic beverages is associated with nutrient deficiency, which appears to contribute independently to oral carcinogenesis [38]. Fruits and vegetables consumption deficit reveled to be the highest risk factor in the studied population. This represents a concerning question taking in account the high percentage of young individual and the cumulative effect risk.

Despite the general accessibility of the oral cavity during physical examination, many malignancies are not diagnosed until late stages of disease [39]. Systematic literature reviews of effectiveness in screening for OC and pre cancer made until early 2000 were found to provide insufficient available data to make an unequivocal determination as to the effectiveness of OC screening programmers at the time [40]. Althought OC is almost always preceded by visible changes in the oral mucosa most situations are currently detected at a late stage, when treatment is complex, costly, and has poor outcomes [41].

Sankaranarayanan and collaborators (2005) performed a landmark study when studied a higk-risk population in India (n= 96.517). They proved for the first time that oral visual inspection

was effective in reducing OC mortality. According to their data, visual oral screening was ascribed to a potential of preventing at least 37.000 OC deaths worldwide [23]. More recently, I-How *et al* (2011) reported a high sensitivity and specificity (98.9% and 98.7%, respectively) in an oral cavity visual screening for cancer conducted in a large male population (more then 13 000 men) from a tertiary medical center [42].

The association of the well-known risk factors for oral cancer and its easy detect ability - it is almost always preceded by visible changes in the oral mucosa - converted this disease into a potentially preventable one [25, 41].

However the diagnostic delay is still a reality – it seems to be assigned by the lack of awareness of the signs, symptoms, and risk factors for OC, as well as a disappointing absence of prevention and early detection by health-care providers [41]. Indeed, a recent survey regarding dentists knowledge of risk factors and diagnostic concepts of OC, Decuseara *et al* (2011) found that they appear to be generally knowledgeable regarding diagnostic concepts and risk factors [43]. Nevertheless, these dentists reported a significant lack of patient education regarding prevention and early detection of OC. The fact that economical disadvantaged populations do not visit a dentist regularly further increases its burden risk.

The low educational level found also may account for social needs resulting as a source of non-healthy lifestyles. It is known that both tobacco and alcohol consumption constitute ancient adaptive strategies to overcome unfavorable conditions - such as hunger and cold - activating the dopaminergic reward system [44].

This fact concur to explain why many Public Health measures aimed at preventing OC fail their final goal whenever the eradication of such non-healthy lifestyles is not considered [42].

Our results corroborate others [35] suggesting that it might be possible to improve OC mortality by modifying country-based determinants lifestyles related (not only smoking and drinking prevalence) and improving multidisciplinary approaches prepared by both Social and Health Sciences – it is fundamental a better knowledge for an efficient action.

Conclusions

The results obtained revealed that smoking habits and fruits-vegetables consumption deficit contributed as the highest risks factors in the studied population. From RFEI analysis, individuals with secondary level and those with sub-urban residential area assumed the highest risk exposure. Alcohol consumption also contributed as a significant higher as a significant risk exposure.

Future oral health measures for this group must take in account-tobacco cessation sessions and nutritional re-education, especially for younger individuals, once these risk factors have a cumulative effect.

Some of these risk factors work as biological reward of quality of life deficit. A wide comprehension of the problem requires a multidisciplinary approach necessarily involving Health and Social Sciences in order to target the core of OC health promotion.

An effective epidemiological strategy must thus support three major aspects: population knowledge, population sensitization and visual screening.

Competing interests

The author(s) declare that they have no competing interests.

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Authors' contributions

AS: conceived of study, participated in the acquisition, analysis and interpretation of data, drafted, revised and submitted the manuscript.

AM: participated in the acquisition of data.

MP: conceived of study, participated in the acquisition of data

EM: was responsible for the instructions and guidelines aimed to scientifically prepare and calibrate the teams involved.

GP: participated in the acquisition of data.

JG participated in analysis and interpretation of data, and performed the statistical analysis.

LC: participated in the acquisition of data.

IG: participated in the acquisition of data.

BC: participated in manuscript elaboration.

CR: participated in the acquisition of data.

TS conceived of study, participated in the analysis and interpretation of data, drafted the manuscript, revised it critically and submitted the manuscript.

All authors read and approved the final manuscript.

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Section II

FORENSIC MEDICINE AND THE MILITARY POPULATION: INTERNATIONAL DENTAL RECORDS AND PERSONAL IDENTIFICATION CONCERNS, *in* Acta Médica Portuguesa

Forensic Medicine and the Military Population: International Dental Records and Personal Identification Concerns

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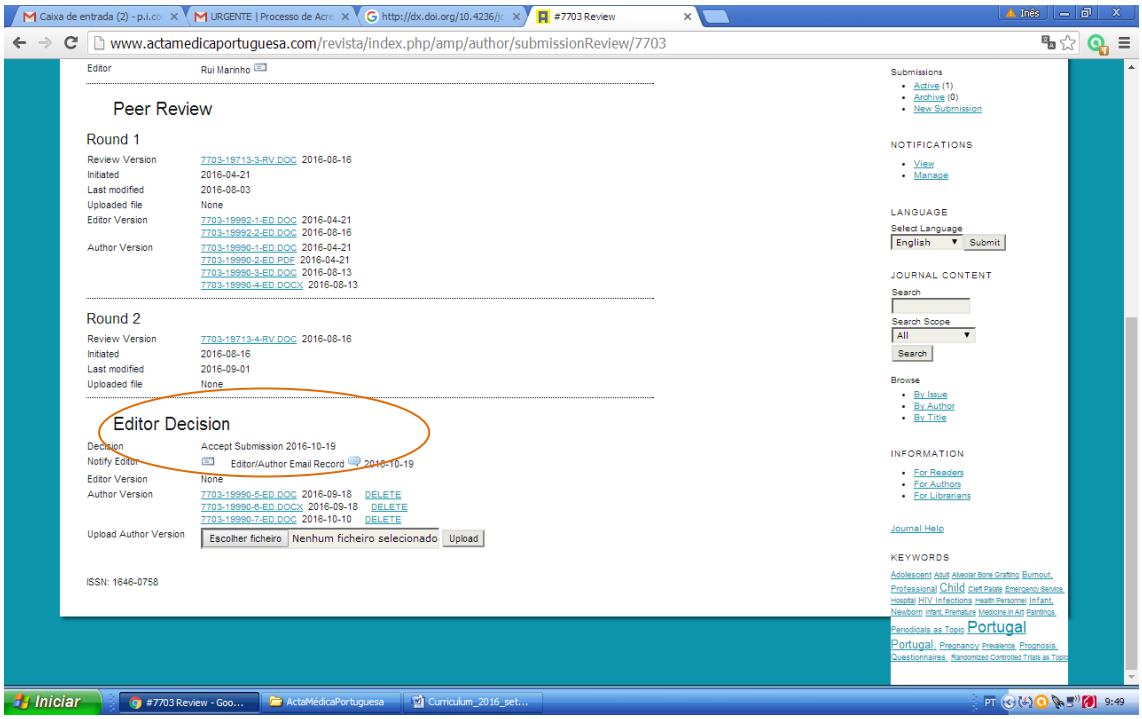

ORIGINAL ARTICLE

Medicina Forense e a População Militar: registos dentários internacionais e sensibilização para a identificação humana

Forensic Medicine and the Military Population: international dental records and personal identification concerns

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RESUMO

Introdução e objetivos: Esta investigação teve o intuito de procurar conhecer o comprometimento global relativamente à organização e arquivo dos registos dentários e compará-lo com o risco de segurança de cada país. Por outro lado, procurou-se estudar os processos clínicos de uma amostra da população militar Portuguesa, utilizando-se para o efeito os registos dentários.

Materiais e Métodos: Foi enviado um *e-mail* para associações dentárias e solicitada informação sobre o tempo de guarda dos registos dentários.

Após autorização prévia da Comissão de Ética, a informação foi recolhida através do sistema “Forensic Dental Symbols®” para “Dental Encoder®”, como uma extensão de uma investigação realizada em Espanha e utilizada a codificação genérica (dentes sãos, com restaurações, ausentes e coroas).

Results Globalmente, dez anos após o último tratamento, foi o regulamento mais comum relativamente ao tempo de guarda dos documentos.

Após observação dos registos dentários da amostra (595 militares) verificou-se um total de 19040 dentes analisados, com as seguintes frequências: dentes sãos (89,6%), com restauração (7,0%), ausentes (2,2%) e coroas (1,1%).

Discussion: Existe grande variedade de orientações sobre quanto tempo têm que ser guardados pelos profissionais de saúde os seus registos.

Nos registos dentários da população militar deve-se incluir informação detalhada de cada dente, de maneira a suportar o processo de identificação humana.

Conclusão: Este artigo reforça a necessidade de registos dentários de qualidade em todos os países, com manutenção eficiente para a identificação humana. Na população militar torna-se especialmente importante, devido ao facto de este ser um grupo sujeito a riscos acrescidos.

Keywords: Medicina forense; Medicina dentária forense; População militar; Identificação humana; Registos dentários.

ABSTRACT

Introduction and aims: The first goal of this research was to perceive the global commitment towards the organization and archiving of dental records and to compare it with each country's security risk rating. The second one was to study dental records in a sample of the Portuguese military population, using the available national dental records.

Material and Methods: An e-mail was sent to representative dentistry associations in several countries, requesting some information concerning the professionals' awareness of this issue.

After obtaining permission from the Ethics Committee, the information was collected through the *Forensic Dental Symbols*® system into the *Dental Encoder*®, as an extension of a Spanish study, and a generic codification was used (unrestored, restored, missing and crowned teeth).

Results: The most common dental record retention period is ten years after treatment.

Observing the sample's dental records (595 files), we found a total of 19,040 analyzed teeth, with the following frequencies: unrestored (89.6%), restored (7.0%), missing (2.2%) and crowned (1.1%).

Discussion: There is a wide range of guidelines on how long dentists should keep dental records.

Especially for the military population, dental records must include detailed information concerning each tooth situation, in order to support the process of human identification.

Conclusion: This article reinforces the need for mandatory quality dental records in all countries, which must be efficiently stored and easily accessible in case dental identification is necessary. For the military population, these requirements are especially important, due to the added risks to which this group is subject.

Keywords: Forensic medicine; forensic odontology; military population; human identification; dental records.

INTRODUCTION

Forensic medicine is the discipline that deals with legal issues supported by medical facts. Personal identification is fundamental as far as medicolegal issues are concerned. Biological criteria must be unique, unchanged and perennial.[1-3] They include a number of attributes that characterize the individual, making him/her unique and distinguishable from others. Such characteristics may be psychological (such as character or intelligence), functional (behavior, gestures, locomotion, sensibility, voice, writing) and physical (race, gender, age, stature, malformations, scars, tattoos, professional signs, biotype). Whereas psychological and functional characteristics contribute to the uniqueness of individuals while they are alive, physical characteristics remain even after their death.[4]

Several authors suggested two types of identification: reconstructive – whenever a probable identification can be suggested based on age, gender, race and height – and comparative, based on a match with previously existing records.[5,6]

No less important are the legal and social aspects of death; we believe that, for all families, whatever their cultural and religious origins, it is important to determine what happened and where their loved ones are; The need for the corpse's identification takes on social and ethical importance, as it is part of the grieving process followed by most religions and cultures. Legal and financial aspects can also be particularly relevant when considering situations of inheritance, pension or life insurance.[7]

Basic sciences, such as anatomy and histology must be developed in order to support forensic medicine. Anatomy concerns include cadaveric dissection, problem-based workshops, plastic models, computer software packages, living anatomy and radiological anatomy.[8,9] These learning methods are key approaches for acquiring important knowledge, very useful for the implementation of best practices and innovation in forensic medicine, in relation to bite mark analysis, body trauma assessment, malpractice assessment and human identification.[10] Histology is used to investigate post-mortem bone modifications, trauma, pathologies, age estimation and to discriminate human and non-human bones.[11]

Teeth are incredibly strong and can withstand temperatures up to 1,200 Celsius degrees. A careful dental examination can produce data such as the person's age,

gender and size, and provide a number of anatomical references that can allow for both identification and exclusion. However, the use of a comparative approach requires high-quality, complete and carefully filled dental records.[12]

Fingerprinting, the most extensively accepted method of human identification, is useless whenever bodies are disfigured, decomposed, burned or fragmented. The anatomical comparison of teeth to previously available records is one of the most important alternatives used for human identification.[12-14]

The physical, chemical and biological characteristics of dental arches make them valuable anatomical elements in case of severe aggression. Military corpses are often exposed to adverse scenarios. Occasionally their identification is only possible through teeth. Forensic odontology enables a comparison between *ante-* and *post-mortem* dental records, providing one of the best ways for establishing personal identification - sometimes it is the only method of identification or exclusion.4[15,16]

Portugal has actively contributed to United Nations peace operations in 4 continents. Over the last 15 years, Portugal has deployed more than 30,000 military personnel abroad in 18 missions.[17]

Conflict risk and post-conflict injury among the military population has been discussed for decades, with regard to mortality and morbidity concerns, and includes information about the different types of aggressors (criminals, protesters or terrorists).[18]

Military health risks have been associated to post-conflict injury and related mortality such as: mental health disorders, traumatic brain injury, suicide, rheumatology injuries, increased cancer risk, alcohol and drug addiction.[19-22] Conflict risks include: military trauma, spine injuries, acute pain, physical and sexual abuse, pandemic diseases and in some cases, death.[23-27]

Due to exposure to these diverse types of danger, the military population has an increased probability of requiring corpse identification. Where *ante-mortem* dental records have been carefully prepared, human identification can be successful even if other elements are missing. Additionally, the cost-effectiveness ratio is very favorable when such method is available. Human identification using previous dental records has proven extremely useful, particularly in mass disasters or extreme situations, such as wars, earthquakes, aeronautical accidents or shipwrecks.[27]

This research had two goals. The first was to understand the commitment towards the organizing and archiving of dental records in a worldwide set of countries, seeking a potential relationship with each country's security risk rating, and to get a perception of the awareness to this issue. The second was to study dental records in the Portuguese military population, based on available national dental records and their value for personal identification.

MATERIAL AND METHODS

A questionnaire on the organization and archival of dental records and on the professional's awareness was sent via email to representative dentistry organizations in the five continents. The addresses used for the survey on the professional's awareness of dental record organization were obtained from the official web page of FDI (World Dental Federation). The associations that took the survey are listed on Table 1, below:

Austria	Osterreichische Zahnärztekammer
Belgium	Chambres Syndicales Dentaires
Denmark	Association of Public Health Dentists in Denmark
Finland	Finnish Dental Association
France	Association Dentaire Française
Netherland	Nederlandse Maatschanppij tot bevordering der Tandheelkunde
Ireland	Irish Dental Association
Iceland	Icelandic Dental Association
Italy	Associazione Italiana Odontoiatri
Luxembourg	College Medical du Luxemburg
Norway	Norwegian Dental Association
Lithuania	Lithuanian Dental Chamber
Portugal	Ordem dos Médicos Dentistas
Spain	Consejo General de Colegio de Odontólogos y Estomatólogos de España
Sweden	Swedish Dental Association
Switzerland	Société Suisse d'Odonto-stomatologie

United Kingdom	British Dental Association
United States	American Dental Association
Canada	Canadian Dental Association
Argentina	Confederación Odontológica de la República Argentina
Brazil	Associação Brasileira de Odontologia
Colombia	Federación Odontológica Colombiana
Costa Rica	Colegio de Cirujianos Dentistas de Costa Rica
Paraguay	Federación Odontológica del Paraguay
China (Hong Kong)	Hong Kong Dental Association
Israel	Israel Dental Association
Russia	Russian Dental Association
Taiwan	Dental Association of Thailand
Turkey	Turkish Dental Association
Guinea-Bissau	Associação Dentária de Guiné-Bissau
South Africa	South African Dental Association
New Zealand	New Zealand Dental Association
Tasmania	Australian Dental Association

Table 1: List of associations.

When considering the countries' risk rating, we used the "International SOS" classification provided for travellers: Extreme, High, Medium, Low and Insignificant risk.[28]

For the study of dental records among the Portuguese military population, we used a sample of 595 individuals whose last dental observation/treatment was between January 2010 and July 2011, provided by the Regional Military Hospital of Porto, Portugal, after obtaining authorization from the relevant authorities (Ethics Committee of the D. Pedro V Military Hospital, Porto).

The information was collected in the form of “Forensic Dental Symbols®” into the “Dental Encoder®” database.[29,30]

In this study we included individuals up to 63 years old, even though the cut-off age for missions is 49. Non-military personnel and incomplete dental records, such as illegible dental situation or missing characterization elements, such as age or gender, as well as ages below 18 years, were excluded.

With respect to dental condition, a dental coding system (generic code) was used[29,30], which classifies dental characteristic into four types, as listed in Table 2, below.

Unrestored	Includes the clinical conditions of healthy teeth, cavities without restoration (regardless of affected surfaces), root fragments, fissure sealants and partially erupted teeth.
Restored	Includes the clinical conditions of restored dental pieces, whatever material used or the surface involved.
Missing	Includes the clinical conditions of missing dental pieces, unerupted teeth, agenesis and crowns for removable dentures.
Crown	Includes the clinical conditions of dental parts carrying a unit fixed prosthesis, bridge pillar or fixed prosthesis pontic or implant crown.

Table 2: Dental classification types.

For statistical inferences, we first performed a Kolmogorov-Smirnov test for each variable, to assess the normality of distribution and the results did not allow concluding that distribution is normal. When the distribution is not normal, it is better to use non-parametric tests, but if the sample is of a large size, it is possible to consider the normality of the distribution. In this work, we used both types of tests – we used the analysis of variance, popularly known as ANOVA and the t-Student test for independent samples, or the Kruskal-Wallis and Mann-Whitney tests, which are, respectively, the corresponding non-parametric tests. The conclusion was the same for all cases. All tests were performed with a 95% confidence level, which, consequently, implies a p-value under 5% to reject the null hypothesis.

RESULTS

Thirty three representative dentistry associations in several countries, located across the five continents, provided feedback, as shown in Table 3, below.

	Country	Risk rating	Dental record Archival and Organization
EUROPE	Austria	Low	10 years (required)
	Belgium	Low	30 years (recommended)
	Denmark	Insignificant	10 years
	Finland	Insignificant	10 years after patient's death 100 years in case of no knowledge of patient's death or 10 years after last treatment
	France	Low	10 years (required)
	Netherlands	Low	15 years (required) or more if deemed necessary
	Ireland	Low	10 years (required)
	Iceland	Insignificant	Forever (required)
	Italy	Low	Not required
	Luxembourg	Insignificant	10 years (required)
	Norway	Insignificant	Forever (required)
	Lithuania	Low	15 years (required)
	Portugal	Low	5 years (recommended)
	Spain	Low	5 years minimum (required)
	Sweden	Insignificant	10 years (required)
	Switzerland	Insignificant	10 years (required)
	United Kingdom	Low	Minimum 11 years after last visit or 25 years of age (required) or Forever (recommended)

AMERICAS	United States	Low	Between 1 and 10 years (required) – varies by state
	Canada	Low	Not required
	Argentina	Low	10 years after patient's death
	Brazil	Medium	4 to 10 years after last treatment or 28 years (required)
	Colombia	Medium	8 years (required)
	Costa Rica	Low	Not required
	Paraguay	Low	10 years
ASIA	China(Hong Kong)	Low	3 years (required)
	Israel	Medium	Forever (required)
	Russia	Medium	75 years (required)
	Taiwan	Low	10 years (recommended)
	Turkey	Low	2 years
AFRICA	Guinea-Bissau	High	Not required
	South Africa	Medium	Forever (minimum 11 years)
OCEANIA	New Zealand	Low	10 years (required)
	Tasmania	Low	7 years or 25 years (required)

Table 3. Dental record archival and organization related to the country's risk rating in the five continents.

Of a total of 33 responses, 17 (51.2%) came from European countries, 7 (21.2%) from the American continent, 5 (15.2%) from Asia, 2 (6.2%) from Africa and 2 (6.2%) from Oceania.

The responses collected had considerable differences: Three countries (9.1%) require keeping dental records forever and five (15.2%) countries do not require that any type of dental record is kept. One country recommends keeping such records for a minimum of 11 years, two recommend 15 years, one 30 years and one 75 years. The most common figure is 10 years or less, with 20 responses – i.e. 20 countries reported requiring or recommending the keeping of dental records during that period.

Additionally, the risk rating of the countries that replied to the data collection emails was predominantly low (20 countries), followed by insignificant (7 countries), medium (5) and lastly, high (1 country).

With regard to the study of the Portuguese military population, Chart 1, below, shows the socio-demographic distribution (Gender / Age Group).

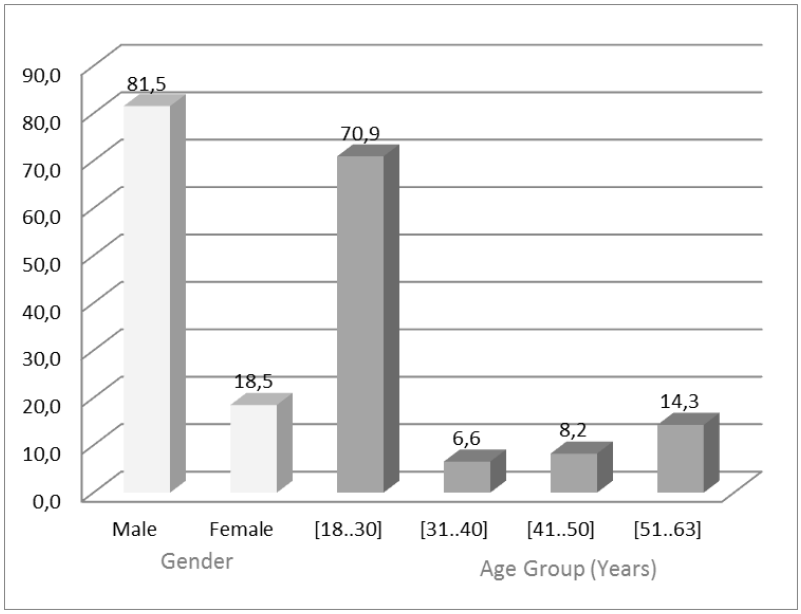

Chart 1. Socio-demographic distribution (Gender / Age Group).

There is a predominance of males (485; 81.5%) over females (110; 18.5%). A chi-square test confirms that this difference is significant ($p<0.001$). Ages were between 18 and 63 years.

Chart 2 shows the oral condition distribution within each Gender / Age Group.

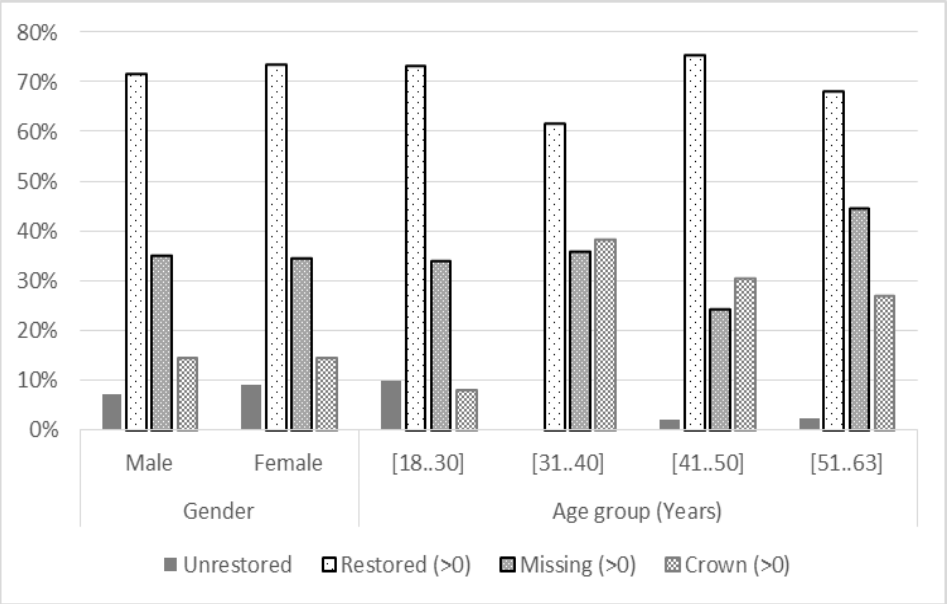

Chart 2. Oral condition by Gender / Age Group.

Oral condition	Sex		Age group				Sex		Age group			
	Male	Female	[18..30]	[31..40]	[41..50]	[51..63]	Male	Female	[18..30]	[31..40]	[41..50]	[51..63]
Unrestored	34	10	41	0	1	2	7.0%	9.1%	9.7%	0.0%	2.0%	2.4%
Restored	347	81	309	24	37	58	71.5%	73.6%	73.2%	61.5%	75.5%	68.2%
Missing	170	38	144	14	12	38	35.1%	34.5%	34.1%	35.9%	24.5%	44.7%
Crown	71	16	34	15	15	23	14.6%	14.5%	8.1%	38.5%	30.6%	27.1%

Table 4. Results by Gender/Age group.

Oral condition frequencies were analyzed in this study, divided into 4 groups: All teeth unrestored; At least one restoration; At least one missing tooth, and At least one crown. In our sample, the most frequent oral condition is Restored (males: 347; females: 81), followed by missing (males: 170; females: 38), crowned (males: 71, females: 16) and unrestored (males: 34, females: 10). The Chi-Square test was performed to analyze the differences in oral condition between males and females. Results (p-value = 0,000) indicate that a difference exists only for unrestored teeth in the second quadrant. In this case, females have more unrestored teeth than males.

None of the military personnel in the 31-40 age group, either males or females, have all teeth unrestored.

The ANOVA statistic test was carried out to analyze the differences in teeth condition between the age groups. The results showed that in the 18-30 age group, the crown code frequency is considerably lower than in other age groups.

We determined the correlation between the several teeth conditions and results show that there is a weak correlation between the four quadrants for all types of condition.

This study included 32 teeth from 595 military personnel. Our sample, which represents a total of 19,040 teeth, was analyzed with a generic codification and the following distribution was found: unrestored 89.6% (17,060 teeth), restored 7.0% (1,338 teeth), missing 2.2% (427 teeth) and crowned 1.1% (215 teeth).

In this sample, 1,980 teeth that have been subject to medical interventions are represented, including restored 67.6% (1,338 teeth), missing 21.6% (427 teeth) and crowned 10.9% (215 teeth).

DISCUSSION

There was a very wide range of responses from Dental Associations about how long dentists should keep dental records. In most countries, the period of time is established after the last intervention. Some countries define specific additional deadlines in case of children, with minimum ages for keeping dental records.

The most common requirement for the retention of dental records is 10 years after the last treatment. Countries with particular extended period requirements are: Israel, Russia, Finland, Iceland, Norway, South Africa and Argentina. Some of these countries have a high/medium risk rating and give special importance to such procedures.

Some countries with more lenient or missing regulations (Guinea-Bissau and Brazil) should be more alert, given their medium and high risk rating. They are not prepared to keep dental records for a significant period of time even though the probability of needing them is higher.

Some authors have studied the qualitative and quantitative impact of dental records in human identification in a mass disaster in Asia in 2005.[31] Victims from

Europe (76.4%), North America (76.5%), Oceania (86.7%) and Africa (75.0%) were identified mainly through dental comparison. The identification rate of missing persons with dental records was significantly higher than that of those without (P<0.01). Most of the victims identified by their dental records were returned to their home country within four months after the disaster. Dental records were the primary identifier in 46.2% of identifications. However, among the Thai citizens reported missing, only 2.0% were identified using dental identification; 18.1% had dental charts and 0.8% had dental X-rays. It should also be noted that only 7.4% of Thai dental records could be used for dental identification and one-third of Thai victims remained unidentified.[31]

In this Portuguese military sample, generic coding was used, as it is more reliable and entails less subjectivity (unrestored, restored, missing or crown). It was also useful to correct many common errors intrinsic to the observer, such as failure to specify the surfaces treated, type of material used, etc. This generic coding system allows grouping cases with similar clinical conditions within the same category, such as all restorations or absence of dental pieces. Thus, this narrower coding tends to reduce and rectify some common errors intrinsic to the observer, such as incorrect delimitation of restored surfaces, the type of material used, the reason for absence of teeth – extraction or no eruption –, the distinction between abutment and pontic fixed prosthesis, among others. This coding system simulates the process of collecting dental data performed by medical forensic dentists.

It would also be important to have more diversity and to specify some additional variables, such as oral hygiene, nutrition, smoking habits and other key factors for oral health results. Additionally, comparison with other samples, namely collected in other countries, would also be useful.

The military population is subject to added health risks during missions (both peace maintenance and war scenarios) and is required to receive dental care shortly before deployment, which increases the potential value of the corresponding records.

There was a wide difference between men and women. Our sample's gender distribution is quite similar to military population records referenced by other authors.32,33 The percentage of females in this sample (18.5%) is similar to that of others (14.3%). In 2008, the Portuguese Defense Ministry, through Dispatch nº 101 of 6 July 2008, determined that military forces institute recruiting regulations that uphold gender equality for all grades and specialties, which certainly contributed to the increasing ratio of females of younger ages.[32]

The reason why there are records of non-military persons among military hospital dental records is that the Military Hospital provides differentiated health care to the military forces as well as to their families, disabled militaries and also provides health care to other patients under subsequent additional agreements.[33]

Access to dental care treatment, provided by the National Health Service, is not freely available to the entire Portuguese population.34,35 This is not the case for military personnel, who have free access to privileged dental care. In 2012, military health services included 7 dentists in the army.35 On the other hand, the younger generations were exposed to increased awareness of the requirement to receive dentist care and dental treatments, which had a visible effect on their oral health condition.

In our sample, the most frequent oral condition is Restored, followed by Missing, Crowned and Unrestored (Table 4).

Oral diseases are a significant public health problem, being considered by FDI as an essential component of the general health status.36 Ii is estimated that about 50% of the Portuguese population does not have access to oral health care, the main root cause for this being financial constraints.[34,35-37]

CONCLUSION

National awareness of the importance of good and properly filled out dental records is not widespread worldwide. This article reinforces the need for mandatory quality dental records in all countries, which must be efficiently stored and easily accessible in case dental identification is necessary.

There are two key factors contributing to an effective human identification through dental records. The first is the regularity of oral health follow-ups and the second is the quality of the dental records, which is the responsibility of health professionals.

This study also indicates the need for an increased sample size in order to be achieve a more accurate representation of the military population, in order to better characterize the diversity of dental treatment records. It is also important to collect data from others sources, to generate more diversity and to specify some additional variables, such as oral hygiene, nutrition, smoking habits and other key factors for oral health results.

Additionally, comparison with other samples, namely collected among the military forces of other countries, would also be useful.

Despite some limitations, this study leads us to emphasize the potential of the analysis of dental records for personal identification concerns.

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Section III

A MEDICINA DENTÁRIA FORENSE E O MUNDO: ARQUIVO DOS REGISTOS DENTÁRIOS E PAÍSES DE RISCO, *in* Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial

A medicina dentária forense e o mundo: arquivo dos registos dentários e países de risco

(Forensic odontology in the world: storage of dental records and risk countries)

Study published (online) in the journal Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial (SPEMD)

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A MEDICINA DENTÁRIA FORENSE E O MUNDO: ARQUIVO DOS REGISTOS DENTÁRIOS E PAÍSES DE RISCO

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Objetivos: A medicina forense é uma ciência que lida com a relação e aplicação de fatos médicos a questões legais, sendo a identificação pessoal fundamental para questões médico-legais. Pretende-se apresentar um trabalho desenhado com o objetivo de perceber o envolvimento e o compromisso do Mundo no arquivo dos registos dentários e de observar a sua relação com os países de risco.

Materiais e métodos: Com o objetivo de alcançar o envolvimento dos cinco continentes foi enviado um e-mail para os órgãos representativos da classe de vários países. Os endereços foram obtidos através da página web oficial da FDI (World Dental Federation), para a qual foi solicitada informação relativa à sensibilização para o arquivo dos registos dentários pelo Médico Dentista. A classificação de risco foi conseguida através da Internacional SOS que dividiu cinco graus considerando as suas forças militares, estado de guerra, controle do governo e da lei, entre outros fatores. São eles grande risco, alto risco, médio risco, baixo risco e risco insignificante.

Resultados: A regulamentação mais comum é o arquivo dos registos dentários por 10 anos após o último tratamento. Israel, Rússia, Finlândia, Islândia, Noruega, África do Sul e Colômbia são alguns dos países que apresentam risco elevado/médio e tais procedimentos deveriam ter uma maior importância. Alguns países sem regulamento ou baixo tempo de guarda dos registos dentários como a Guiné-Bissau e o Brasil deveriam estar mais alerta por causa de médio e alto risco que representam.

Conclusões: Mundialmente nem sempre os países em análise têm uma relação entre o grau de risco e a sensibilidade para a importância de registos dentários eficientes e atualizados. É importante reforçar a necessidade de registos de carácter obrigatório em todos os países, armazenados de forma eficiente e de fácil acesso.

Section IV

IDENTIFICAÇÃO HUMANA: O CONTRIBUTO DOS REGISTOS DENTÁRIOS, *in* Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial

Identificação humana: o contributo dos registos dentários

(Human identification: the contribution of dental records)

Study published (online) in the journal Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial (SPEMD)

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IDENTIFICAÇÃO HUMANA: O CONTRIBUTO DOS REGISTOS DENTÁRIOS

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Introdução: A Medicina Dentária Forense constitui um método relevante para a identificação de cadáveres e restos cadavéricos, tanto em casos individuais como em grandes catástrofes. O potencial identificativo das técnicas dentárias tem sido amplamente demonstrado ao longo da história da Humanidade. Através da comparação da ficha dentária anterior, com a actual situação dentária do cadáver e os sinais ainda conservados na dentição, é possível chegarmos a conclusões sobre a identificação humana.

Com este trabalho pretende-se dar a conhecer a informação constante de uma ficha dentária, criada especialmente para auxiliar na identificação humana.

Metodologia: Revisão bibliográfica no B-on e Pubmed. Foram seleccionados artigos em inglês e português entre 2000-2010 recorrendo-se às palavras-chave: “dental records”, “ficha dentária”, ”human identification”.

Resultados: Os principais elementos de comparação são a posição de cada dente e suas características; a existência de cáries e a sua localização precisa; a ausência de uma ou várias peças dentárias; a presença de restos radiculares; a

existência de próteses removíveis, fixas e/ou aparelho ortodôntico; os detalhes de cada restauração, bem como o material utilizado e a face envolvida.

Relativamente às características de cada dente é de realçar a condição de cada dente no que diz respeito à cor, erosão, limpeza, existência de malformações e tipo de dente (temporário ou permanente). O conhecimento das propriedades anatómicas normais dos dentes humanos, macro e microscópicas, é de grande interesse para o perito.

Conclusão: O registo de características extra-orais, assim como, das intra-orais são elementos chave para a identificação humana e é importante que os Médicos Dentistas / Médicos Estomatologistas estejam conscientes dessa importância.

O fundamento do método de identificação dentária reside na análise das similitudes e discordâncias observadas entre os dados *post-mortem* e as características orais *ante-mortem* da vítima, razão pela qual a busca dos antecedentes dentários confirma uma etapa técnica muito importante.

Section V

DENTAL DIVERSITY PATTERNS: RELEVANCE IN PORTUGUESE MILITARY POPULATION, submitted for publication

Dental diversity patterns: relevance in Portuguese military population

Submitted for publication

ORIGINAL ARTICLE

Dental diversity patterns: relevance in Portuguese military population

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ABSTRACT

Introduction: This research's purpose was to build a dental database of a Portuguese military population, to understand the frequency and distribution of different conditions/pathologies found in each dental piece.

Methodology: This is a retrospective study and was based on a sample of 1636 military workers of the Portuguese Armed Forces. Dental data was collected using the Forensic Dental Symbols® and Dental Encoder® database, Microsoft Excel, and SPSS v.23. Teeth were named following the FDI notation system. The statistical analysis used were the Kolmogorov-Smirnov, ANOVA, t-Student, Kruskal-Wallis and Mann-Whitney.

Results The analysed sample was composed of 83.4% of men and 16.6% of women.

Discussion: The age group with most individuals was 23-27 years, with a frequency of 32%. The most frequent code in the 32 teeth was "unrestored." Individuals with ≤32 years had healthier teeth and fewer missing teeth.

Conclusion: Although inconclusive, the dental condition allows classifying individuals based on their age. The low variability of dental conditions found in the sample limits the analysis and, hence, the number of potential inferences. Studying more heterogenic populations could provide more conclusive results and allow the extraction of additional knowledge.

Keywords: Forensic dentistry; Military dentistry data; Military medicine; Medical records department, Hospital; Victims identification.

INTRODUCTION

The Portuguese Civil Code states, in Article 66, paragraph 2, that: “The rights recognized by the law to the unborn child depend on his or her birth” and, in Article 68, paragraph 2, that: “A person whose corpse was not found or identified is presumed dead, when the disappearance took place in circumstances that leave no doubt as to his or her death”abaixo[1].

Humans are exposed to multiple situations in their daily life, both in a professional and personal scope, despite being civils, military people or military people in civil activity. Thus, they may be exposed to natural or human-made disasters at any moment.

Nowadays, the Portuguese Military Forces assume a major role by participating in international missions and making commitments to comply with the significant responsibilities taken by Portugal before its peers in the North Atlantic Treaty Organization (NATO), European Union (EU), and United Nations (UN). Therefore, high proficiency and assurance are required in the preparation of the Military Forces beyond the operational training, including an accurate assessment based on the selection criteria standards defined by NATO[2]. One of the main criteria outlined by NATO for militaries to be considered qualified in the recruitment stage is their oral health situation. Before recruitment, soldiers must fulfill NATO’s minimum oral health requirements, according to the “NATO Guide for Assessing Deployability for Military Personnel with Medical Conditions”[3]. The mentioned NATO Guide states that military personnel must fulfill Dental Fitness Classes 1 or 2 (Dental Fitness Class 1: no dental treatment required and no further dental appointments required for existing conditions – fully capable; Dental Fitness Class 2: military personnel whose existing dental condition is unlikely to result in a dental emergency within 12 months).That classification is aimed to prioritize dental care, minimize the number of emergencies due to dental problems, and emphasize the importance of oral health for all military forces, both active and in reserve[4].

Ideally, only militaries with Dental Fitness Classes 1 and 2 should be selected; however, the detailed definition of each class and final assessment differs between countries. Many countries have standard operational policies that include some conditions within Class 3 as acceptable. Others do not require a strict classification by clinical personnel for risk assessment. In the case of doubt, when assigning a classification, the highest classification should be considered[5].

A dental examination to determine military people's Dental Fitness should also be done when they are being selected for missions, and dental records should be completed according to the established form by the health entity performing the assessment.

Military personnel's Dental Fitness is assessed and determined by dentists in a military base during dental visits (which occur periodically, before missions, in urgencies or for a specific treatment). Dental Fitness is considered acceptable for all military personnel when their oral care is not expected to require assistance or improbable treatments in the following 12 months[6].

By definition, militaries with Dental Fitness Classes 3 or 4 (Dental Fitness Class 3: military personnel who have a dental condition that is likely to cause a dental emergency within 12 months or a dental condition that is currently under care, but likely to result in a dental emergency if treatment is not completed; Dental Fitness Class 4:military personnel who require an annual examination, have an undetermined dental status, have no dental record, or have an incomplete dental record) should not be selected.

Military Dental Medicine may provide multiple types of action: preventive measures, assistance, expertise assessment, and operation support. All these actions are essential both in Military Bases and foreign operations and are highly related to each other. As a preventive measure, epidemiological surveillance of oral and dental health is conducted to maintain the population's oral health. Assistance is provided to determine oral and dental diagnoses, proceed with urgent treatments, and ensure military personnel's readiness for functions. Expertise assessment is required to support the Chief of Health Services concerning oral health and involves assessing all suffered lesions and determining incapacity for service due to oral-dental conditions.

Therefore, it is particularly important to evaluate the oral condition of military personnel because they are additionally exposed to serious injuries whose negative impact on identification is potentially higher.

The purpose of this research was to build a dental database of a Portuguese military population to know the frequency and distribution of different medical conditions or pathologies found in each dental piece. Based on the collected data, the probability of the different tooth patterns occurring and their variability in the reference population group were determined. These data were used to calculate the frequencies of the various tooth patterns in the population and, using statistical models, to

determine the certainty degree obtained in the identification of an individual based on dental condition.

MATERIALS AND METHODS

A sample of 1636 professional military personnel of the Portuguese Armed Forces was used to pursue this research's goal. This study was carried out in compliance with the personal data protection law, according to the international recommendations of the World Medical Association for clinical research gathered in the Helsinki Declaration. Data collection and usage were conducted with the permission of the Ethics Committee of the D. Pedro V Military Hospital, Porto, Portugal, thus fulfilling the personal data protection law. Dental data was collected using the Forensic Dental Symbols® and Dental Encoder® database[7,8,9], Microsoft Excel, and SPSS v.23. Teeth were named following the FDI (World Dental Federation) notation system.

Dental classification in this study followed the general proposal by Martinez-Cicón, which is based on four types of teeth. To record dental characteristics, a dental coding system was used as reported in a previous study to classify characteristic into four types: 1, Unrestored, which includes healthy teeth, cavities without restoration (regardless of the surfaces involved), root fragments, fissure sealants and partially erupted teeth; 2, Restored, which includes restored teeth regardless of the material used or the surfaces involved; 3, Missing, which includes missing teeth, unerupted teeth, agenesis and crowns in removable dentures; and 4, Crown, which includes teeth with a single fixed prosthesis, bridge pillar or fixed prosthetic pontic or implant crown.

Using that general codification, similar clinical conditions were grouped into the same category. For instance, all restorations and all missing teeth were grouped together. This summarized coding system limits and corrects potential interpretation differences between observers associated within correct delimitation of restored surfaces, types of material used, reason for missing roots (extraction or unerupted), distinction between the abutment and the pontic of fixed prosthesis, among others. This coding system is a simulation of the collection method used by forensic dentists or dentists.

For statistical inferences, we first performed a Kolmogorov-Smirnov test, for each variable, to verify normality of distribution; the results did not indicate that the distribution was normal. When the distribution is not normal, nonparametric tests are recommended; however, when the sample is very large, the normality of distribution can be considered. Thus, in this work, both types of test were used: the analysis of

variance (ANOVA) and the t-Student test for independent samples, and the Kruskal-Wallis and Mann-Whitney tests, which are the correspondent nonparametric tests. The conclusion was the same for all cases. All tests were performed with a 95% confidence level, which implies a p-value lower than 5% to reject the null hypothesis.

RESULTS

For frequency analysis, individuals were grouped by sex, age group, and dental condition to understand the source of the collected data.

Table 1 represents distribution by sex and age group in the Portuguese military population. The population is mostly male, as confirmed by the sample, with 83.4% of men and 16.6% of women.

Sex	#	**%**
Male	1365	83.4%
Female	271	16.6%
Age Group	#	**%**
18-22	234	14.3%
23-27	524	32%
28-32	193	11.8%
33-37	56	3.4%
38-42	66	4%
43-47	102	6.2%
48-52	147	9%
53-57	129	7.9%
>57	185	11.3%

Table 1: Distribution by sex and age group (in years) in the Portuguese military population.

The age group with most individuals is 23-27 years, showing the highest incidence of Portuguese military population – 32%. Following that age group are groups 18-22 years and 28-32 years, with 14.3% and 11.8% of the population, respectively. A significant percentage of the population – 58.1% – was under 33 years old. The lowest percentage was 3.4%, found in age group 33-37 years, followed by 4% in 38-42 and 6.2% in 43-47.

Table 2 presents the distribution by tooth and dental condition of the Portuguese military sample.

Dental Condition	Unrestored		Restored		Missing		Crown	
Tooth	#	%	#	%	#	%	#	%
18	1486	90.8%	44	2.7%	105	6.4%	1	0.1%
17	1397	85.4%	184	11.2%	34	2.1%	21	1.3%
16	1313	80.3%	210	12.8%	44	2.7%	69	4.2%
15	1383	84.5%	151	9.2%	32	2.0%	70	4.3%
14	1398	85.5%	134	8.2%	24	1.5%	80	4.9%
13	1546	94.5%	64	3.9%	6	0.4%	20	1.2%
12	1509	92.2%	78	4.8%	8	0.5%	41	2.5%
11	1486	90.8%	103	6.3%	6	0.4%	41	2.5%
21	1476	90.2%	95	5.8%	7	0.4%	58	3.5%
22	1509	92.2%	79	4.8%	9	0.6%	39	2.4%
23	1543	94.3%	55	3.4%	10	0.6%	28	1.7%
24	1431	87.5%	105	6.4%	34	2.1%	66	4.0%
25	1403	85.8%	130	7.9%	34	2.1%	69	4.2%
26	1288	78.7%	211	12.9%	61	3.7%	76	4.6%
27	1406	85.9%	173	10.6%	40	2.4%	17	1.0%
28	1493	91.3%	52	3.2%	90	5.5%	1	0.1%
48	1475	90.2%	68	4.2%	93	5.7%	0	0.0%
47	1333	81.5%	227	13.9%	47	2.9%	29	1.8%
46	1236	75.6%	213	13.0%	69	4.2%	118	7.2%
45	1473	90.0%	108	6.6%	19	1.2%	36	2.2%
44	1547	94.6%	56	3.4%	11	0.7%	22	1.3%
43	1595	97.5%	15	0.9%	12	0.7%	14	0.9%
42	1600	97.8%	13	0.8%	10	0.6%	13	0.8%
41	1586	96.9%	23	1.4%	14	0.9%	13	0.8%
31	1593	97.4%	15	0.9%	15	0.9%	13	0.8%
32	1584	96.8%	20	1.2%	15	0.9%	17	1.0%
33	1600	97.8%	16	1.0%	7	0.4%	13	0.8%
34	1549	94.7%	50	3.1%	8	0.5%	29	1.8%
35	1464	89.5%	117	7.2%	22	1.3%	33	2.0%
36	1236	75.6%	220	13.4%	66	4.0%	114	7.0%
37	1337	81.7%	202	12.3%	56	3.4%	41	2.5%
38	1475	90.2%	82	5.0%	78	4.8%	1	0.1%

Table 2: Distribution by tooth and dental condition.

The most frequent code in the 32 teeth was “unrestored.” The frequency of unrestored teeth varied between 97.8% in teeth 33 and 42 and 75.6% in teeth 36 and 46. Regarding restored teeth, their frequency was highest in teeth 47 (13.9%) and 36 (13.4%), and was lowest in teeth 42 (0.8%), 43 (0.9%), and 31 (0.9%). The “missing” code was most frequent in teeth 18 (6.4%) and 48 (5.7%) and least frequent in teeth 13, 11, 21, and 33, all with 0.4%. Crowns were most frequent in teeth 46 (7.2%) and 36 (7.0%), while teeth 18, 28, 38, and 48 had very few or no occurrences of crowns, with values between 0.1% and 0.0%.

K-means clustering analysis was performed with two and three clusters to search for grouping patterns with similar conditions. Clustering with two groups resulted in one group with 300 and other with 1336 members. With three clusters, sample distribution resulted in groups with 320, 1298, and 18 members. Because with three clusters one group had very few cases, the analysis followed the two-cluster division.

Tables 3 show, respectively, sex and age group proportions in each cluster. In order to know if the clusters were related to the several age groups and sex, a chi-square test was performed for each variable. The results showed differences regarding age groups (p-value = 0.000) but none for sex (p-value = 0.602).

Sex		**Cluster 1**	**Cluster 2**
Male	#	1105	260
	%	82.7%	86.7%
Female	#	231	40
	%	17.3%	13.3%
Age Group			
18-22	#	**222**	12
	%	**16.6%**	4.0%
23-27	#	**463**	61
	%	**34.7%**	20.3%
28-32	#	**167**	26

	%	**12.5%**	8.7%
33-37	#	45	11
	%	3.4%	3.7%
38-42	#	45	21
	%	3.4%	7.0%
43-47	#	79	23
	%	5.9%	7.7%
48-52	#	92	**55**
	%	6.9%	**18.3%**
53-57	#	91	**38**
	%	6.8%	**12.7%**
>57	#	132	**53**
	%	9.9%	**17.7%**

Table 3: Sex and Age group (in years) distribution in each cluster.

Individuals under 33 years old were most related to one cluster and individuals over 48 years old were most related to the other cluster. Age groups between 33 and 47 were not specifically highly related to any of the clusters, with similar proportions in each of them.

Cluster 1 has a younger group, more unrestored teeth, and fewer missing teeth, while Cluster 2 has older individuals, fewer healthy teeth, and more missing teeth.

Considering the differences in frequencies shown in Table 3, the Kolmogorov-Smirnov test was performed to verify the normality of data, in order to decide the type of test to use. The results showed that there was no normality (p-value = 0.000), and, thus, a Wilcoxon test (a nonparametric test that is equivalent to the parametric t-Student test for paired samples) was performed for all combinations of teeth pairs. Results showed that the difference was not significant, meaning that dental condition does not vary much between teeth.

Teeth were grouped into the two clusters' patterns as shown in Table 4.

	1Q	2Q	3Q	4Q
Cluster 1	1,2,3,8	1,2,3,7,8	1,2,3,4,5,8	1,2,3,4,5,8
Cluster 2	4,5,6,7	4,5,6	6,7	6.7

Table 4: Standardization of dental condition.

Teeth 11, 21, 31, 41, 12, 22, 32, 42, 13, 23, 33, 43, 18, 28, 38, and 48 were found only in Cluster 1, while teeth 16, 26, 36, and 46 were found only in Cluster 2. Teeth 14, 24, 34, 44, 15, 25, 35, 45, 17, 27, 37, and 47 were found in both clusters, even though the second molar from the second quadrant was only in Cluster 1.

In Cluster 1, which had a higher number of younger people, teeth 11, 21, 31, 41,12, 22, 32, 42, 31, 32, 33, and 43 were healthier than 18, 28, 38, and 48, which are usually more absent. In Cluster 2, which had a higher number of older people, teeth 16, 26, 36, and 46 were the most frequently restored and the least healthy, due to the previously mentioned reason.

The ratio of each tooth's dental condition was also analyzed by age group (Table 5).

Age Group	Tooth condition	u	r	m	c
18-22	**Average**	0,9345	0.0503	0.0142	0.0013
	Stand. Dev	0,0569	0.0472	0.0191	0.0043
23-27	**Average**	0,9039	0.0703	0.0190	0.0077
	Stand. Dev	0,0681	0.0492	0.0202	0.0096
28-32	**Average**	0,9087	0.0648	0.0123	0.0200
	Stand. Dev	0,0630	0.0474	0.0133	0.0173
33-37	**Average**	0,8965	0.0703	0.0126	0.0229
	Stand. Dev	0,0815	0.0451	0.0214	0.0387
38-42	**Average**	0,8719	0.0790	0.0168	0.0371
	Stand. Dev	0,0945	0.0582	0.0214	0.0389
43-47	**Average**	0,8500	0.1058	0.0223	0.0242

	Stand. Dev	0,0899	0.0633	0.0223	0.0275
48-52	**Average**	0,8526	0.0752	0.0161	0.0590
	Stand. Dev	0,0816	0.0506	0.0145	0.0491
53-57	**Average**	0,8674	0.0645	0.0226	0.0471
	Stand. Dev	0,0745	0.0385	0.0202	0.0416
>57	**Average**	0,8419	0.0616	0.0439	0.0542
	Stand. Dev	0,0525	0.0290	0.0216	0.0300

Legend: u - unrestored; r - restored; m - missing; c – crown.

Table 5: Average and Standard Deviation for Distribution of dental condition by age group (in years).

Considering ratio as a variable (continuous quantitative variable), significant differences were searched in the proportions of the various age groups. Again, the Kolmogorov-Smirnov test showed no normality (p-value = 0.000), and the Wilcoxon test was conducted to verify if the observed difference was significant in the sample. Each age group was compared with all others (two by two), and no significant differences were found in the results.

The results of this analysis do not allow establishing a pattern of tooth condition based on age group.

DISCUSSION

A chi-square test confirmed that the prevalence of the male sex with 83.4% (1365 men) was significant. This difference may result from the fact that military service was mandatory for men until recently, while it was not common for women.

Our sample's sex distribution is coherent with the military population records referred by some authors[10,11]. Our sample's female proportion (16.6%) was coherent with the reported for the military population, where, in 2011, from a total of 17,592 military personnel, 2520 were female, thus representing 14.3% of the population. In 2008, the Portuguese Ministry of Defense, according to the law Dispatch No. 101 from July 6th, 2008, determined that the recruitment of candidates to military forces should respect sex equality and involve accessing all grades and specialties; certainly, that law strongly contributed to the female ratio growth in younger ages[10]. Since 2003,

Portugal abolished the mandatory military service, becoming optional to the whole population.

Considering the “unrestored” code, teeth with the highest frequency were the lower antero lateral teeth. These teeth are less exposed to dental caries processes that would require restorations because they do not have the occlusal surface, and are less subjected to direct injury because they are protected by the upper jaw. On the opposite side, the inferior first and second molars are more likely to suffer diseases that require treatments from dentists.

The “restored” code was most common in the first and second molars due to their anatomical occlusal surface and their considerable role in the chewing process. Teeth with the lowest rates of restoration were the lower antero lateral teeth due to the same reasons as mentioned above in the “unrestored” code.

The “missing” code was most frequent in the third molars. That finding may be associated with those teeth’s anatomical conditions and late eruption, as well as with their subsequent eruption. On the other hand, the teeth with the lowest missing frequencies were canines and incisors, which are less frequently affected by pathological processes and, thus, are less subject to extractions. Furthermore, due to aesthetic reasons, those teeth are less frequently extracted and an increased effort is made to keep them.

Regarding the “crown” code, it should be highlighted that it was infrequent in all teeth. First molars stood out in this category probably because they are the first permanent teeth to erupt early, being the most susceptible teeth to suffer from diseases that require dentist’s treatments. Additionally, due to their anatomical occlusal surface, first molars may require early prosthetic intervention. On the contrary, the teeth that had crowns least often were the third molars. This low frequency may be justified by the fact that crowns are very unusually held in those posterior teeth and when teeth are conveniently positioned, the patient and the dentist usually choose to extract this tooth prior to its rehabilitation.

The younger group (≤32 years) had healthier teeth and fewer missing teeth, which may result from the many prevention programs that have emerged recently in Portugal. Following previous oral healthcare programs with very restricted access since 1999, in2009, the Portuguese political health strategy changed and increased its scope. The National Oral Health Promotion Program (“cheque-dentista” – dentist voucher) was created to reach some groups with high risk of caries. This program

includes curative and preventive treatments and provides financial support for oral care using private resources. That program was initiated by decree No. 301/2009of March 24th, published in the Portuguese Official Government Gazette, 1st series, No. 58, of March 24th, 2009. Additionally, the Portuguese Ministry of Health has been developing strategies to improve awareness, promotion, and prevention on oral healthcare within the public health system.

In Portugal, although oral health is included in primary health care, as previously mentioned, it is primarily provided by private entities, with few or no public support. This situation is a considerable obstacle to the accessibility to oral health care, especially to the population with poor economic conditions, which is a significant group in Portugal[12,13].

Some studies conducted in military populations show that the prevalence of dental emergencies increases with age, being least frequent in the age group 20-30 years and most frequent in the group >51years[5].

Two clusters resulted from the standardization of dental condition, for all quadrants. Cluster 1 was more associated with younger people, and Cluster 2 was more associated with older people. This distinction may be important for the medical and legal areas for human identification, particularly in the age group >48 years. That is the age from which a more significant difference between the younger and older population is observed. This observation resulted from the analysis of the two age groups in pairs mentioned above.

The fact that incisors and upper canines are healthier may result from younger people being more aware of aesthetic needs and, thus, following preventive measures for their oral health.

Very frequently, dental pieces and their specific characteristics are extremely useful for human identification. For instance, in the 2004 Asian tsunami, experts from many countries conducted human identification based on the study of their teeth. Forensic odontology was responsible for 70.3% of the identifications alone and 5.4% in combination with fingerprints study[14]. According to the Disaster Victim Identification (DVI), forensic odontology is one of the three primary identifiers, along with fingerprints and DNA, and, thus, a multidisciplinary team of experts is required in a disaster situation[14,15,16,17].

Human or natural disasters are events that affect the lives of multiple individuals at a given time and place. Examples of such disasters are hurricanes, tornados, floods, earthquakes, and also human-made disasters, such as terrorist attacks or wars, and all these may affect a large number of people[18]. However, the most common problem faced by a forensic team during human identification is the poor state of conservation of the unidentified bodies and the incomplete presence of remains, which may delay the identification process; in these situations, an oral autopsy maybe a solution[19].

CONCLUSION

The Portuguese military population was characterized based on their dental condition. It was found to be a very homogeneous population with reduced variability. This finding means increased complexity for the identification of patterns that allow the identification of clearly distinct groups within the population.

Although statistical tests were inconclusive, the dental condition allows individuals classification based on age. It is possible to clearly distinguish two age groups (under 33 years and over 47 years), with the interval between 32 and 48 years being a transition zone. In this sense, this work indicates that it is possible to infer with considerable confidence whether the individual's age is higher than 32 years or lower than 48 years, based on their mouth’s dental condition.

The “sex” variable did not reveal any significant differences.

The sample analyzed in this study is representative of the Portuguese military population, and, thus, extrapolation of the results is possible.

The short variability of dental conditions found in the sample, which reflects the population under study, restricts the analysis and, hence, the number of inferences that could be drawn. Studying more heterogenic populations could provide more conclusive results and the extraction of additional knowledge from the sample.

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Section VI

ESTUDIO COMPARATIVO DE LA DIVERSIDAD DE LAS CARACTERÍSTICAS CLÍNICAS DENTALES EN POBLACIONES MILITARES DE PORTUGAL Y ESPAÑA, *in* Revista Española de Medicina Legal.

Estudio comparativo de la diversidad de las características dentales en poblaciones militares de Portugal y España

(Diversity in dental clinical characteristics in Portuguese and Spanish military populations)

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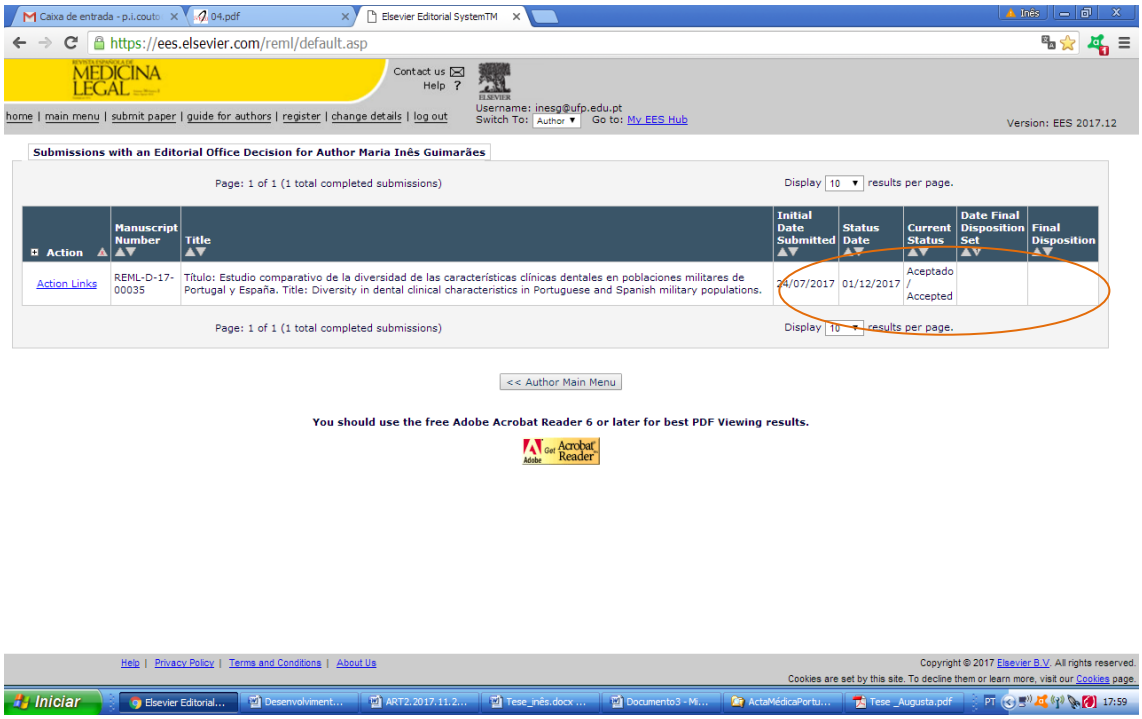

ORIGINAL ARTICLE

Estudio comparativo de la diversidad de las características clínicas dentales en poblaciones militares de Portugal y España.

Diversity in dental clinical characteristics in Portuguese and Spanish military populations.

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RESUMEN

Introducción: Se ha realizado una comparación de las características dentales de dos poblaciones militares de Portugal y España. El objetivo principal de esta investigación fue identificar aquellas características dentales que podrían ser de utilidad para diferenciar estas poblaciones en un análisis forense.

Material y métodos: El estudio se realizó en una muestra compuesta por 5136 personal militar profesional de las fuerzas armadas, siendo el 31.9 % militares portugueses, y 68.1% del total de la muestra de las fuerzas armadas españolas. Los datos dentales se registraron empleando los símbolos dentales descritos en Forensic Dental Symbols®, gestionados con la base de datos Dental Encoder®.

Resultados: La población de estudio estaba constituida por un 86.6% de hombres (88.1% en la muestra española y 83.4% en la muestra portuguesa), y un 13.4% mujeres (11.9% en la muestra española y 16.6% en la muestra portuguesa). La frecuencia de dientes no restaurados fue menor para los primeros molares en todos los cuadrantes, mientras que la mayor frecuencia de esta característica (> 90%) se observó en los dientes anteriores, superiores e inferiores, y los primeros premolares inferiores. Las frecuencias más altas de tratamientos restauradores fueron encontradas para los primeros y segundos molares en todos los cuadrantes, y las mayores frecuencias de ausencias dentarias se observaron en los terceros molares (superior al 28% en todos los cuadrantes). El análisis de concordancia mostró que las correlaciones entre los dientes contralaterales fueron significativamente mayores que entre los dientes antagonistas, para ambas muestras poblacionales de estudio.

Conclusiones: Nuestros resultados proporcionan información potencialmente útil sobre la importancia de las bases de datos de registros dentales y el análisis de las características dentales con fines de identificación.

ABSTRACT

Introduction: Dental characteristics was compared in population samples of Spanish and Portuguese military personnel. The main goal of this study was to identify those dental characteristics that could potentially serve to differentiate between these populations in a forensic analysis.

Material and methods: A sample of 5136 individuals belonging to the professional military staff of the Portuguese and Spanish armed forces was studied. Dental data were recorded with the Forensic Dental Symbols® for the Dental Encoder® database. The population sample analyzed here consisted of 68.1% Spanish and 31.9% Portuguese individuals.

Results: The population was mostly male with 86.6% men (88.1% in the Spanish sample versus 83.4% in the Portuguese sample) and 13.4% women (11.9% Spanish and 16.6% Portuguese). The frequency of unrestored teeth was lowest for first molars in all quadrants, and the highest frequency of unrestored teeth (>90%) was for the upper and lower anterior teeth and lower first premolars. The highest frequencies of restoration were found for the first and second molars in all quadrants, and the highest frequencies of missing teeth were found for the third molars (always >28%). Concordance analysis showed that correlations between contralateral teeth were significantly higher than between antagonist teeth in both samples.

Conclusions: Our findings provide potentially useful information on the importance of dental record databases and their value for identification purposes.

PALABRAS CLAVE: Odontología forense, Registros dentales, Diversidad dental, Datos de población militar, Identificación humana.

KEYWORDS: Forensic dentistry, Dental records, Dental diversity, Military Population Data, Human identification.

INTRODUCCIÓN

La identificación humana requiere la determinación de aquellas características particulares o conjunto de cualidades que distinguen a la persona de todas las demás y la hacen única. Todas las personas nacen con una identidad y tienen el derecho de morir con ella. El establecimiento de la identidad plantea además una serie de cuestiones tanto de índole legal (herencias, custodias o seguros de vida) como de índole psicológica para las familias y los amigos del fallecido (la agonía de la espera y los prolongados intentos de identificación infructuosos), todo ello sin olvidar las implicaciones sociales y políticas. [1,2]

Entre los métodos de identificación disponibles destaca el estudio odontológico. La enorme variedad de características individualizadoras que nos proporcionan los dientes y maxilares humanos resulta de inestimable valor para el establecimiento de la identidad del sujeto, ya que, partiendo de una población cerrada de individuos, una sola de estas características puede confirmar la identidad de un individuo o permitir su exclusión.[3]

La identificación dental se logra con éxito cuando la comparación entre los registros dentales *antemortem* y *postmortem* revela una coincidencia significativa, y la ausencia de discrepancias absolutas, lo que asegura un grado considerable de certeza respecto a la identidad del sujeto basada en los registros dentales disponibles.[4] Si se proporcionan datos clínicos completos, los odontólogos forenses pueden concluir la identificación dental en un corto espacio de tiempo y con una elevada certeza, debido a la variabilidad inherente y la singularidad de la dentición humana.[5] A pesar de ello, a menudo se requiere que los odontólogos forenses establezcan la probabilidad de identificación en los tribunales, tal y como se realiza en la genética forense, donde el cálculo de la probilidad de identificación o razón de verosimilitud es posible debido a que se dispone de las frecuencias de los diversos marcadores génicos en poblaciones concretas.[6]

Sin embargo, la escasez de datos epidemiológicos sobre la distribución de frecuencias de las diversas situaciones clínicas (patologías y tratamientos) para cada diente y en poblaciones de distinto origen, dificulta el cálculo de probabilidades en la identificación dental. En este sentido, para contribuir a la estimación de las probabilidades de la diversidad de patrones, diversos autores han venido realizando estudios sobre las frecuencias de los patrones de tratamientos y patologías dentales en población civil y militar.[5-15]

Para las fuerzas militares involucradas en misiones de paz o guerra, la identificación humana resulta de particular importancia. Debido a que a menudo se encuentran expuestos a situaciones de riesgo extremo, resulta más probable que el personal militar requiera una identificación si se compara con la población civil.[1,16] Es por ello que se han desarrollado protocolos específicos para regular los procedimientos técnicos de identificación de víctimas miembros de las Fuerzas Armadas.[17,18]

Las comparaciones de datos dentales de personal militar de diferentes países pueden determinar si estas poblaciones son distinguibles en función de sus características dentales con fines de identificación forense. En el presente estudio, se determinaron las diferencias y similitudes en las características dentales de una muestra de población militar española y portuguesa. El objetivo principal de esta investigación fue identificar aquellas características dentales que podrían ser de utilidad para diferenciar estas poblaciones, en un análisis forense con fines de identificación humana.

MATERIAL Y MÉTODOS

Los datos analizados procedieron de una muestra de 5136 individuos pertenecientes al cuerpo militar profesional de las fuerzas armadas portuguesa y española. El estudio se realizó de acuerdo con las leyes de protección de datos personales, en conformidad con las recomendaciones internacionales de la Asociación Médica Mundial para la investigación clínica, tal y como se establece en la Declaración de Helsinki. La investigación y recogida de datos, se realizó con sendas autorizaciones del Comité de Ética del Hospital Militar D. Pedro V de Oporto (Portugal), y del Ministerio de Defensa español, en cumplimiento de las normativas relativas a los derechos de los pacientes, y de protección de datos personales. En todos los casos, se obtuvo un documento de consentimiento informado por cada paciente, con la autorización para el uso epidemiológico y estadístico de sus datos dentales.

Los dientes se identificaron y nombraron de acuerdo con la nomenclatura FDI. Las características clínicas dentales se registraron en sus correspondientes odontogramas, mediante el sistema Forensic Dental Symbols®, empleándose para su análisis y gestión, la base de datos Dental Encoder®, [6,19] diseñadas y adaptadas a los formularios dentales de DVI, propuestos por Interpol.[20]

Para el análisis de las características dentales, se utilizó un sistema de codificación dental aplicado en un estudio anterior[11] que clasifica dichas características en cuatro tipos: 1, No restaurado, que incluye dientes sanos, cavidades sin restauración (independientemente de las superficies involucradas), restos radiculares, selladores de fisuras y dientes parcialmente erupcionados; 2, Restaurado, que incluye dientes restaurados independientemente del material utilizado o las superficies involucradas; 3, Ausente, que incluye dientes exodonciados, dientes no erupcionados, agenesias y coronas de prótesis removibles; y 4, Corona, que incluye dientes con corona, pilares de puentes, pónticos de prótesis fijas y coronas de implantes.

Con este sistema de codificación, los casos con características clínicas similares se agrupan en la misma categoría, como ocurre con todos los dientes restaurados o ausentes, independientemente de la razón. Este sistema resumido de codificación, tiende a disminuir y rectificar algunos errores comunes intrínsecos a las observaciones, que incluyen entre otros, la delimitación incorrecta de las superficies restauradas o el tipo de material utilizado, la razón de la ausencia de un diente (exodonciado o no erupcionado), y la distinción entre pilar y póntico en las prótesis fijas. Además, este sistema simula el proceso de recopilación de datos dentales por parte de los odontólogos forenses en grandes catástrofes.[20]

Los datos recopilados incluyeron la edad de los individuos, por lo que, para el presente análisis, se categorizó la muestra en ocho grupos de edad: 18-22, 23-27, 28-32, 33-37, 38-42, 43-47, 48-52 y > 53 años. La principal razón que justifica esta agrupación, se debe a la ausencia de información detallada de las características dentales por edad, y la necesidad de realizar un estudio estadístico más preciso. Con esta doble finalidad, se diseñó esta nueva variable (denominada "grupo de edad") en la que la muestra se categorizó en grupos de cinco años de edad. Además, el tamaño de la muestra, para cada categoría y población, fue lo suficientemente amplio para su análisis estadístico posterior.

Para el análisis de los datos, se procedió al correspondiente estudio estadístico para inferir las relaciones entre las variables, de ambas poblaciones, de acuerdo con sus características dentales, sexo y grupo de edad. Estos análisis se centraron en:

a. Diferencias entre dientes adyacentes (que presentan contacto permanente entre sí de modo que comparten la misma posición en la arcada dentaria).

b. Diferencias entre dientes antagonistas (que establecen contacto durante la oclusión para cortar o moler alimentos durante la masticación).

c. Diferencias entre dientes contralaterales (con una distancia equivalente entre ellos, en su posición en la cavidad bucal y durante la masticación, cuya morfología se asemeja a la de su homólogo contralateral ubicado en la hemiarcada derecha o izquierda, y que erupcionan al mismo tiempo).

d. Principales factores diferenciadores (análisis de componentes principales).

Para todos los modelos estadísticos aplicados en los análisis e inferencias estadísticas se utilizó un intervalo de confianza al 95%. Dado el tamaño de la muestra (5136), se emplearon pruebas paramétricas para la variable ordinal (grupo de edad), y pruebas no paramétricas para las variables categóricas. Todos los estudios estadísticos se llevaron a cabo empleando herramientas de Excel, Dental Encoder® y SPSS versión 23.0.

RESULTS

La muestra de población estudiada estaba compuesta por un 68.1% de militares españoles, y un 31.9% de militares portugueses. En relación al sexo, el conjunto de las dos poblaciones, un 86.6% eran hombres (88.1% en la muestra española y 83.4% en la muestra portuguesa) frente a un 13.4% de mujeres (11.9% en la española y 16.6% en la portuguesa). Aunque se detectaron diferencias significativas en cuanto a las proporciones de ambos sexos ($p = 0.000$), la diferencia observada entre nacionalidades no fue estadísticamente significativa.

En cuanto a la distribución de la muestra por grupo de edad, el grupo más amplio fue el comprendido entre los 23 y los 27 años, tanto en la muestra portuguesa como en la española. Del total de personas de cada nacionalidad, el 32.0% de los portugueses se encontraban en este grupo de edad, frente al 28.4% de los españoles. Las proporciones relativas en otros grupos de edad también difirieron entre las muestra portuguesa y española, con un 14.3% de individuos portugueses en el grupo de 18 a 22 años y un 11.8% en el grupo de 28 a 32 años, mientras que, entre los militares españoles, el 20.6% se encontraba en el grupo de 18 a 22 años y el 23.3% en el grupo de 28 a 32 años.

En todos los grupos de edad, el número de mujeres fue inferior al de hombres; sin embargo, las distribuciones en los grupos de edad variaron según el sexo. Tanto para los hombres como para las mujeres, el grupo de edad que incluía a la mayor parte de los individuos tenía entre 23 y 27 años, aunque estas cifras representaban el 48.8% de todas las mujeres frente al 26.6% de todos los hombres. En todos los grupos de edad mayores de 38 años, la proporción de mujeres nunca fue superior al 1.6% del total de este sexo, mientras que la proporción de hombres en estos grupos fue consistentemente mayor al 5.4%.

En relación a la distribución de las características dentales para cada diente, sin distinguir entre nacionalidades, los primeros molares presentaron las frecuencias más bajas de dientes no restaurados (50.9-60.8%). En los dientes anteriores

superiores e inferiores y los primeros premolares inferiores la frecuencia de los dientes no restaurados fue superior al 90% (89.6-98.8%). Las frecuencias más altas de dientes restaurados se observaron en los primeros y segundos molares en todos los cuadrantes (20.8-28.4%) mientras que las frecuencias más altas de dientes ausentes se encontraron para los terceros molares (28.6-32.7%).

La frecuencia relativa de coronas fue baja y varió entre el 0.1 y el 4.3%. Sin embargo, las coronas fueron más frecuentes en los incisivos (11 [3.3%], 21 [3.7%]), los premolares (14 [3.5%], 15 [3.5%], 24 [3.2%] y 25 [3.3%]) y los primeros molares (16 [3.1%] y 26 [3.5%]) superiores, mientras que en el maxilar inferior fueron más frecuentes en los primeros molares (36 [4.1%] y 46 [4.3%]).

Se construyó una tabla de contingencia para cada nacionalidad, diente y característica dental (Tabla 1). Las pruebas de Chi cuadrado revelaron diferencias significativas entre poblaciones para todos los dientes (p = 0.000).

Tabla 1. Tabla de contingencia por nacionalidad para cada diente y característica dental.

Número de diente	Característica dental		1er cuadrante		2º cuadrante		3er cuadrante		4º cuadrante	
			Esp.	Port.	Esp.	Port.	Esp.	Port.	Esp.	Port.
8	N	No.	1781	1486	1841	1493	1859	1475	1894	1475
		%	50.9%	90.8%	52.6%	91.3%	53.1%	90.2%	54.1%	90.2%
	R	No.	144	44	125	52	236	82	221	68
		%	4.1%	2.7%	3.6%	3.2%	6.7%	5.0%	6.3%	4.2%
	A	No.	1573	105	1531	90	1397	78	1378	93
		%	44.9%	6.4%	43.7%	5.5%	39.9%	4.8%	39.4%	5.7%

Número de diente	Característica dental		1er cuadrante		2º cuadrante		3er cuadrante		4º cuadrante	
			Esp.	Port.	Esp.	Port.	Esp.	Port.	Esp.	Port.
7	C	No.	2	1	3	1	8	1	7	0
		%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0%
	N	No.	2427	1397	2436	1406	2084	1337	2038	1333
		%	69.3%	85.4%	69.6%	85.9%	59.5%	81.7%	58.2%	81.5%
	R	No.	916	184	895	173	1088	202	1127	227
		%	26.2%	11.2%	25.6%	10.6%	31.1%	12.3%	32.2%	13.9%
	A	No.	121	34	128	40	281	56	279	47
		%	3.5%	2.1%	3.7%	2.4%	8.0%	3.4%	8.0%	2.9%
	C	No.	36	21	41	17	47	41	56	29
		%	1.0%	1.3%	1.2%	1.0%	1.3%	2.5%	1.6%	1.8%
6	N	No.	1789	1313	1833	1288	1585	1236	1597	1236
		%	51.1%	80.3%	52.4%	78.7%	45.3%	75.6%	45.6%	75.6%
	R	# No.	1249	210	1187	211	1132	220	1197	213
		%	35.7%	12.8%	33.9%	12.9%	32.3%	13.4%	34.2%	13.0%
	A	No.	372	44	378	61	685	66	601	69
		%	10.6%	2.7%	10.8%	3.7%	19.6%	4.0%	17.2%	4.2%

Número de diente	Característica dental		1er cuadrante		2º cuadrante		3er cuadrante		4º cuadrante	
			Esp.	Port.	Esp.	Port.	Esp.	Port.	Esp.	Port.
5	C	No.	90	69	102	76	98	114	105	118
		%	2.6%	4.2%	2.9%	4.6%	2.8%	7.0%	3.0%	7.2%
	N	No.	2708	1383	2737	1403	2955	1464	2934	1473
		%	77.4%	84.5%	78.2%	85.8%	84.4%	89.5%	83.8%	9.0%
	R	No.	457	151	443	130	340	117	355	108
		%	13.1%	9.2%	12.7%	7.9%	9.7%	7.2%	10.1%	6.6%
	A	No.	226	32	221	34	154	22	156	19
		%	6.5%	2.0%	6.3%	2.1%	4.4%	1.3%	4.5%	1.2%
4	C	No.	109	70	99	69	51	33	55	36
		%	3.1%	4.3%	2.8%	4.2%	1.5%	2.0%	1.6%	2.2%
	N	No.	2775	1398	2800	1431	3281	1549	3264	1547
		%	79.3%	85.5%	8.0%	87.5%	93.7%	94.7%	93.3%	94.6%
	R	No.	428	134	400	105	119	50	135	56
		%	12.2%	8.2%	11.4%	6.4%	3.4%	3.1%	3.9%	3.4%
	A	No.	198	24	201	34	81	8	78	11
		%	5.7%	1.5%	5.7%	2.1%	2.3%	0.5%	2.2%	0.7%

Número de diente	Característica dental		1er cuadrante		2º cuadrante		3er cuadrante		4º cuadrante	
			Esp.	Port.	Esp.	Port.	Esp.	Port.	Esp.	Port.
		No.	99	80	99	66	19	29	23	22
	C	%	2.8%	4.9%	2.8%	4.0%	0.5%	1.8%	0.7%	1.3%
		No.	3318	1546	3324	1543	3466	1600	3471	1595
	N	%	94.8%	94.5%	95.0%	94.3%	99.0%	97.8%	99.2%	97.5%
		No.	39	64	35	55	10	16	7	15
	R	%	1.1%	3.9%	1.0%	3.4%	0.3%	1.0%	0.2%	0.9%
3		No.	77	6	59	10	17	7	14	12
	A	%	2.2%	0.4%	1.7%	0.6%	0.5%	0.4%	0.4%	0.7%
		No.	66	20	82	28	7	13	8	14
	C	%	1.9%	1.2%	2.3%	1.7%	0.2%	0.8%	0.2%	0.9%
		No.	3194	1509	3190	1509	3476	1584	3474	1600
	N	%	91.3%	92.2%	91.1%	92.2%	99.3%	96.8%	99.3%	97.8%
		No.	139	78	148	79	6	20	4	13
2	R	%	4.0%	4.8%	4.2%	4.8%	0.2%	1.2%	0.1%	0.8%
		No.	68	8	68	9	12	15	17	10
	A	%	1.9%	0.5%	1.9%	0.6%	0.3%	0.9%	0.5%	0.6%

Número de diente	Característica dental		1er cuadrante		2º cuadrante		3er cuadrante		4º cuadrante	
			Esp.	Port.	Esp.	Port.	Esp.	Port.	Esp.	Port.
1	C	No.	99	41	94	39	6	17	5	13
		%	2.8%	2.5%	2.7%	2.4%	0.2%	1.0%	0.1%	0.8%
	N	No.	3145	1486	3127	1476	3465	1593	3464	1586
		%	89.9%	90.8%	89.3%	90.2%	99.0%	97.4%	99.0%	96.9%
	R	No.	192	103	204	95	5	15	8	23
		%	5.5%	6.3%	5.8%	5.8%	0.1%	0.9%	0.2%	1.4%
	A	No.	34	6	35	7	22	15	20	14
		%	1.0%	0.4%	1.0%	0.4%	0.6%	0.9%	0.6%	0.9%
	C	No.	129	41	134	58	8	13	8	13
		%	3.7%	2.5%	3.8%	3.5%	0.2%	0.8%	0.2%	0.8%

N, no restaurado; R, restaurado; A, ausente; C, corona.

Esp., española; Port., portuguesa.

En relación a las características, nuestros datos mostraron que la mayoría de los dientes no presentaban restauraciones. En los dientes anteriores (incisivos y caninos), la proporción de dientes no restaurados fue muy similar en las poblaciones española y portuguesa. Sin embargo, las dos poblaciones difirieron en la distribución relativa de las características dentales para los primeros, segundos y terceros molares. Las pruebas T para muestras pareadas revelaron diferencias significativas en la forma siguiente:

• Para primeros, segundos y terceros molares; la frecuencia de dientes restaurados fue significativamente mayor en la población española, mientras que la proporción de dientes sin restaurar fue significativamente mayor en la población portuguesa.

• Para los primeros y terceros molares; la frecuencia de dientes ausentes fue significativamente mayor en la población española.

• Para los primeros y segundos premolares; la frecuencia de dientes restaurados y ausentes fue menor en la muestra portuguesa, aunque las diferencias entre las poblaciones española y portuguesa no fueron significativas.

• Para los incisivos centrales y laterales; la proporción de dientes ausentes fue mayor en la muestra española en el primer y segundo cuadrantes, mientras que esta proporción fue más alta en la muestra portuguesa en el tercer y cuarto cuadrante. Sin embargo, las diferencias no fueron significativas.

El análisis de concordancia mediante el coeficiente kappa de Cohen para contrastar los datos entre dientes contralaterales (Tabla 2), mostró un buen acuerdo en los pares (18-28) y (41-31), y un acuerdo moderado para los pares restantes. Entre los pares con acuerdo moderado, el coeficiente kappa fue igual o superior a 0.5 para los pares (11-21), (12-22), (17-27), (42-32), (43-33), (47-37) y (48-38). El análisis de concordancia también mostró que las correlaciones entre los dientes contralaterales fueron significativamente mayores (es decir, nunca menores de 0.4) que entre los dientes antagonistas en ambas muestras. Los niveles de concordancia para los pares de dientes antagonistas fueron consistentemente bajos (Tabla 2) para todos los dientes en la población portuguesa y para los pares (11-41), (12-42), (13-43), (21-31), (22-32) y (23-33) en la población española. En general, los niveles de concordancia fueron bajos o moderados, en lugar de buenos o muy buenos.

Tabla 2. Análisis de concordancia.

	CONTRALATERALES				ANTAGONISTAS		
	Esp.	**Port.**	**Ambas nacionalidades**		**Esp.**	**Port.**	**Ambas nacionalidades**
11*21	B (0.63)	M (0.45)	M (0.58)	**11*41**	P (0.05)	P (0.07)	P (0.06)
12*22	M (0.58)	A (0.34)	M (0.51)	**12*42**	P (0.06)	P (0.10)	P (0.07)
13*23	M (0.47)	A (0.33)	M (0.43)	**13*43**	P (0.11)	P (0.20)	P (0.14)
14*24	M (0.49)	A (0.22)	M (0.43)	**14*44**	A (0.24)	P (0.12)	A (0.21)
15*25	M (0.45)	A (0.26)	A (0.40)	**15*45**	A (0.31)	P (0.10)	A (0.26)
16*26	M (0.49)	A (0.24)	M (0.47)	**16*46**	A (0.36)	P (0.11)	A (0.34)
17*27	M (0.55)	A (0.22)	M (0.50)	**17*47**	M (0.41)	P (0.17)	A (0.38)
18*28	M (0.59)	A (0.29)	B (0.62)	**18*48**	A (0.36)	P (0.17)	M (0.42)
41*31	B (0.62)	B (0.72)	B (0.67)	**21*31**	P (0.05)	P (0.04)	P (0.05)
42*32	M (0.58)	M (0.50)	M (0.53)	**22*32**	P (0.06)	P (0.08)	P (0.07)
43*33	M (0.50)	M (0.49)	M (0.50)	**23*33**	P (0.11)	P (0.17)	P (0.14)
44*34	M (0.49)	A (0.33)	M (0.44)	**24*34**	A (0.23)	P (0.10)	P (0.20)
45*35	M (0.48)	A (0.22)	M (0.42)	**25*35**	A (0.29)	P (0.11)	A (0.25)
46*36	M (0.51)	A (0.29)	M (0.49)	**26*36**	A (0.34)	P (0.13)	A (0.33)
47*37	M (0.56)	A (0.30)	M (0.53)	**27*37**	M (0.44)	P (0.09)	A (0.39)
48*38	M (0.53)	A (0.29)	M (0.55)	**28*38**	A (0.37)	P (0.14)	M (0.42)

P, pobre (≤0.20); A, aceptable (0.21–0.40); M, moderada (0.41–0.60); B, buena (0.61-0.80); MB, muy buena (0.81–1.0).

Esp., española Port., portuguesa.

En la muestra española, los dientes contralaterales mostraron una mejor concordancia que en la muestra portuguesa para 13 de los 16 pares de dientes. Una situación similar se encontró en los dientes antagonistas; las concordancias fueron nuevamente más altas en la población española para 10 de los 16 pares de dientes. Sin embargo, las concordancias para los dientes antagonistas fueron generalmente más bajas en ambas muestras, por lo que este subconjunto de pares de dientes proporcionó menor poder discriminatorio que el subconjunto de pares de dientes contralaterales. En resumen, el análisis de concordancia proporcionó información de uso (junto con otros factores) para diferenciar entre poblaciones.

El análisis de componentes principales (cada componente representa una proporción de cada variable) se realizó con tres muestras diferentes: todos los registros de ambas muestras, la población española solamente, y la muestra portuguesa solamente. Sobre la base de la rotación varimax con normalización de Kaiser, se extrajeron siete componentes de las tres muestras, y la composición de los componentes fue la misma para las tres muestras, es decir, los dientes, la edad y el sexo se agruparon de la misma manera en cada muestra. La Tabla 3 muestra el peso de cada factor (dientes / sexo / grupo de edad) en cada componente para la muestra completa. Se identificaron seis componentes, tal como se resume en la Figura 1, que muestra los factores que produjeron las mejores correlaciones. El componente número siete incluyó las variables “grupo de edad” y “sexo”.

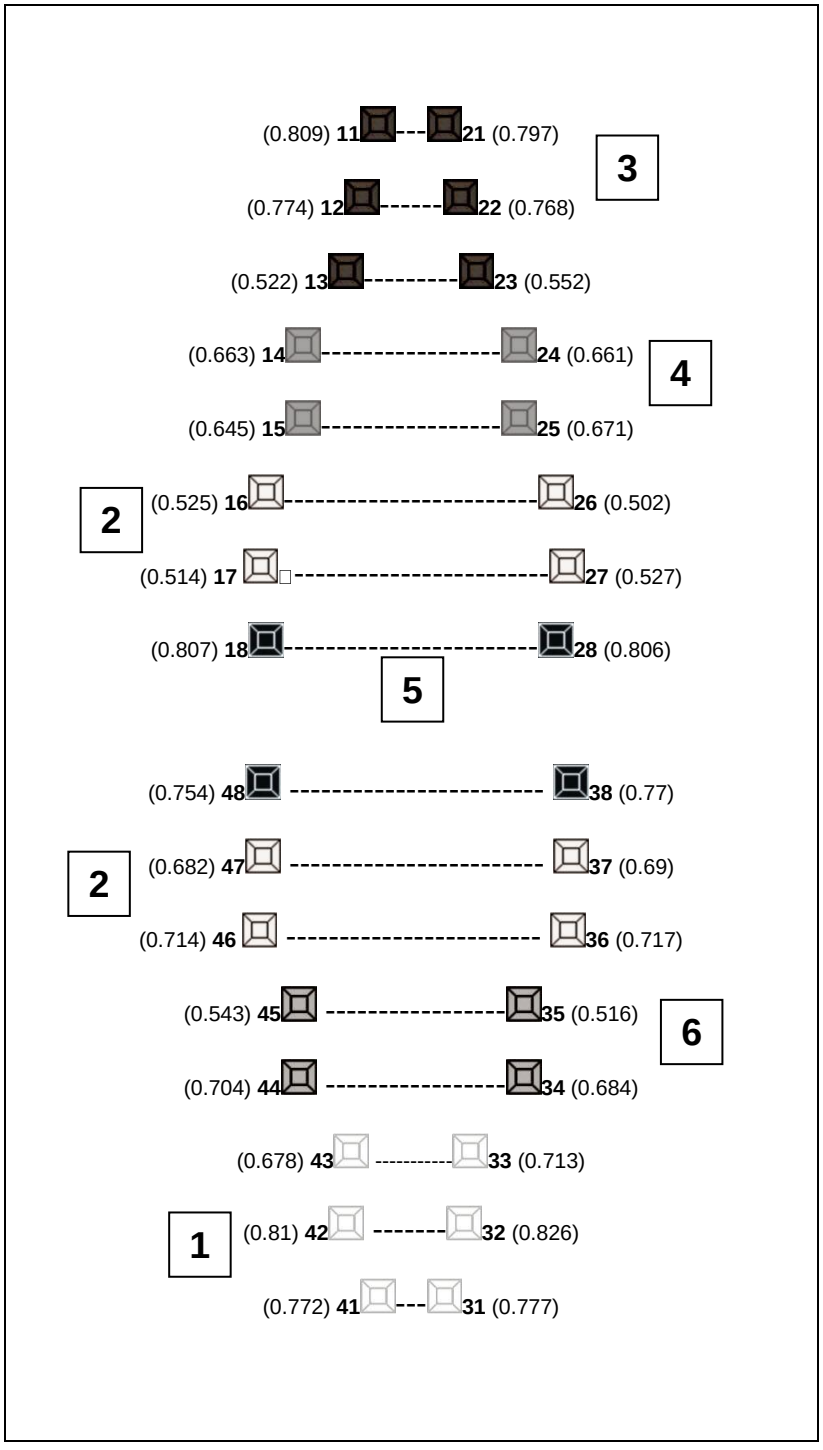
Tabla 3. Pesos de cada componente principal agrupado de acuerdo con la rotación varimax con normalización de Kaiser.

	1	**2**	**3**	**4**	**5**	**6**	**7**
18	0,006	0,084	0,004	0,028	0,807	0.05	-0,017
17	0,083	0,514	0,134	0,408	0.09	0,002	-0,029
16	0,036	0,525	0,042	0,452	0,071	-0,082	0,018
15	0,034	0,225	0,104	0,645	0,042	0,127	0,117

14	0,043	0,115	0,177	0,663	0,021	0,232	0,017
13	0.13	0,011	0,522	0,336	0,048	0,119	0,048
12	0.05	0,103	0,774	0,163	0.03	0,062	-0,002
11	0,041	0.15	0,809	0,005	-0,004	-0,007	0,009
21	0,031	0,113	0,797	0,026	-0,009	0,007	0,038
22	0,082	0,097	0,768	0,095	0,037	0,073	0,016
23	0,144	0,006	0,552	0.33	0,056	0,179	0,015
24	0,024	0,159	0,157	0,661	0,032	0,207	0.01
25	0,046	0,205	0,127	0,671	0,039	0,095	0,077
26	0,031	0,502	0,052	0,461	0,064	-0,086	-0,004
27	0,075	0,527	0,098	0,394	0,108	-0,019	-0,057
28	0,004	0,052	0.02	0,038	0,806	0,022	0,004
48	0,019	0,114	0,029	0,061	0,754	0,015	0,012
47	0,008	0,682	0,068	0,178	0,118	0,151	0,011
46	0,002	0,714	0,089	0,039	0,038	0,142	0,068
45	0.05	0.38	0.11	0,143	0,053	0,543	0,111
44	0,185	0,081	0,065	0,175	0,013	0,704	-0,046
43	0,678	-0,005	0,061	0,028	0,006	0,224	0,003

42	0.81	0,041	0,046	0,016	-0,004	0,047	-0,012
41	0,772	0,037	0,083	0,065	0,015	-0,051	0,033
31	0,777	0,022	0,091	0,086	0.02	-0,027	0,038
32	0,826	0,026	0,048	0,028	-0.01	0,087	0,006
33	0,713	0,025	0,055	0,013	0,008	0.23	0,043
34	0,187	0,042	0,069	0,144	0,024	0,684	-0,075
35	0,038	0,389	0,116	0,112	0,052	0,516	0,092
36	0,025	0,717	0,069	0,035	0,041	0,147	0,053
37	-0,011	0.69	0,084	0,144	0,106	0,146	0,015
38	0	0,129	0,047	0,053	0.77	0,013	-0,017
Sex	-0.005	0,044	-0,018	0,019	-0.05	0,053	-0,866
Grupo de edad	0.118	0,222	0,083	0,289	-0,102	0,069	0,582

Figura 1. Pesos de cada componente principal agrupado de acuerdo con la rotación varimax con normalización de Kaiser.



DISCUSIÓN

Las muestras analizadas son representativas de las poblaciones de estudio, por lo que los resultados pueden ser extrapolables a toda la población de personal militar portugués y español. La proporción de hombres y mujeres fue similar en las dos muestras de población, por lo que creemos que estaba justificado combinar las muestras portuguesas y españolas para el análisis de concordancia (Tabla 2), y el análisis de componentes principales (Tabla 3).

Las similitudes entre las dos muestras de población fueron considerables. La proporción de hombres y mujeres, así como el estado general de salud dental, no difirió significativamente. La distribución de grupos de edad también fue similar. Para identificar elementos discriminadores en la población, fue necesario combinar las variables "grupo de edad" y "característica dental" para cada diente.

Debido a su superficie anatómica oclusal, los primeros molares, tanto superiores como inferiores, son más susceptibles a las patologías que requieren tratamiento dental. Además, este diente, al ser el primero de la dentición permanente en erupcionar, puede estar expuesto a una mayor probabilidad de desgaste y exodoncia prematura u otros tratamientos.

Sin embargo, la frecuencia de dientes restaurados fue más baja en los dientes anteriores superiores e inferiores. Estos dientes no tienen superficies oclusales, por lo que son menos susceptibles a las caries que requieren tratamiento.

La incidencia de dientes ausentes fue más alta para los terceros molares, probablemente porque estos dientes, debido a razones anatómicas, a menudo no erupcionan, y los dientes no erupcionados son susceptibles de indicación exodóntica.

Las coronas en los dientes superiores (incisivos, caninos y premolares) fueron más frecuentes que en los molares, por tratarse de piezas más visibles y ser la prótesis la indicación terapéutica más frecuente por razones principalmente estéticas.

Los primeros, segundos y terceros molares dieron lugar al mayor número de diferencias significativas entre las dos poblaciones. Los dientes con restauraciones fueron más frecuentes en la población española. Un estudio de 1992 realizado por Casañas *et al.*[21] investigó la incidencia de caries dental en una población de escolares de Barcelona (España). La cohorte de edad en su muestra corresponde casi exactamente a la muestra de población de adultos que estudiamos aquí, en la cual la

incidencia de caries fue del 49.2%. Entre los dientes permanentes con caries, el 63.4% había sido restaurado. Un estudio de 1996 de Dolado *et al.*[22] también analizó la incidencia de caries en Barcelona e informó que el 51% de los dientes permanentes presentaban caries. Estos valores están muy influenciados por la conciencia nutricional y el cuidado dental en los niños, y esto puede haber contribuido significativamente a las diferencias encontradas en nuestro estudio. En este sentido, un estudio epidemiológico de 1990 realizado por Peña y Bermejo[23] en niños de 4 a 5 años en Alicante (España) encontró que los niños que asisten a escuelas públicas tienen una frecuencia de caries (49.5%) considerablemente mayor que los niños de escuelas privadas (35.2%), de quien se espera que provenga de familias que pertenecen a un nivel socioeconómico más alto que el promedio. Se sabe que las caries ocurren con menor frecuencia en los niños que consumen menores cantidades de alimentos con un alto contenido de azúcar.

Los primeros molares estaban ausentes con mayor frecuencia en la población española que en la portuguesa. Esta diferencia puede reflejar la influencia favorable de los programas de salud pública implementados en Portugal desde 1985, que se han centrado en la prevención y tratamiento dental y se han dirigido a la población joven.[24] Un factor adicional de relevancia es que el 47% de la población española indica que la crisis económica ha influido en la frecuencia de visitas al dentista.[24,25]

La concordancia para la condición dental general fue más alta en la población española, lo que posiblemente indica que la salud oral recibe más atención en España que en Portugal. Este hallazgo puede estar relacionado con la imagen corporal, que parece ser más valorada entre los españoles.

Las tasas más altas de concordancia se encontraron para los pares de dientes (41-31), (18-28), (11-21) y (48-38). Este puede ser explicado por el hecho de que los pares (41-31) y (11-21) son los más cercanos y, por lo tanto, los más expuestos, a grados de agresión similares en la cavidad oral. Debido a su visibilidad, los pacientes pueden solicitar tratamientos equivalentes en estos dientes por razones estéticas. Los pares (18-28) y (48-38) son los últimos dientes en erupcionar y comparten características similares con respecto al espacio limitado para su erupción y la frecuencia de la categoría "ausente".

El análisis del componente principal identificó siete componentes, de los cuales el sexo y el grupo de edad se correlacionaron (Tabla 3), aunque no se encontraron otras correlaciones para los otros seis componentes con los pesos más altos. Estos

componentes involucraron características dentales, y se encontraron para los dientes con características posicionales compartidas u otras similitudes, de la siguiente manera:

• El componente 1 consistió principalmente en los dientes anteriores inferiores.

• El componente 2 consistió principalmente en los primeros y segundos molares de todos los cuadrantes.

• El componente 3 consistió principalmente en dientes anteriores superiores.

• El componente 4 consistió principalmente en primeros y segundos premolares superiores.

• El componente 5 consistió principalmente en terceros molares en todos los cuadrantes.

• El componente 6 consistió principalmente en primer y segundo premolares inferiores.

Las correlaciones encontradas aquí reflejan claramente la anatomía y la posición del diente en el maxilar. Como se señaló anteriormente, estos seis componentes se correlacionaron más débilmente con el grupo de edad y el sexo.

CONCLUSIONES

Las dos poblaciones comparadas fueron similares en cuanto a la proporción de hombres y mujeres y el estado general de salud dental. El análisis de concordancia mostró que las correlaciones entre los dientes contralaterales fueron significativamente mayores que entre los dientes antagonistas en ambas poblaciones. Además, se identificaron elementos con potencial discriminatorio en ambas poblaciones. Este estudio determinó similitudes y diferencias en la condición dental que pueden ser de aplicación como método auxiliar en la identificación humana. La investigación adicional en esta área, especialmente con muestras que ofrezcan información más detallada sobre las características dentales, puede contribuir de forma significativa a la odontología forense al facilitar el uso de estas características tanto para la identificación dental positiva como para la exclusión de la identidad en la práctica forense.

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Chapter V.
General Discussion

In this Chapter, we aim to discuss generally the several studies and integrate their information. The structure of this thesis, by including 2 published papers, 1 paper submitted for publication, 2 presentations in national conferences published in an indexed journal, 1 presentation in an international conference and 1 paper published in a non-indexed journal, entails the detailed discussion of the results obtained in each stage of development of this Research Project.

According to the Constitution of the Portuguese Republic, all individuals have the right to their personal identity and human dignity (art. 26.1). The Article 6 of the United Nations Universal Declaration of Human Rights states that “Everyone has the right to recognition everywhere as a person before the law” (Universal Declaration of Human Rights, 2014).

Regarding Civil Matter, the Portuguese Civil Code declares, in article 66, no.2, that the rights recognized by law to fetuses depend on their birth and, in article 68, no.2, that a person whose corpse is not found or identified is presumed dead whenever their disappearance has occurred in circumstances that leave no doubt regarding their death. On the other hand, the Spanish Civil Code manages a person's identity as a matter of public order that is required for certain acts, such as the transfer of rights (article 685). The identification of corpses is a previous requirement for proceeding with the certification of their death and with the corresponding registration of their passing in the Civil Record (art. 274 of the Civil Registry Law). If it is not possible to perform the latter, the remains cannot be buried, which will cause further legal problems, namely, their rights and property cannot be transferred to their legal heirs.

These articles reflect that there are increasingly more requirements regarding administrative, criminal, civil, social and economic aspects and, thus, human identification is crucial for protecting the individual and collective interests of the society.

To identify a person and establish their individuality is to determine the traits or set of qualities that distinguish them from everyone else and make them themselves. One problem that is quite frequent in the forensic expert practice is the resolution of cases related to human identification.

Forensic Odontology may be useful in human identification because each person has their own dental profile, which makes them inimitable, and, thus, this process is of relevance in the establishment of identity.

The studies developed in the context of this thesis fit in this area of Forensic Odontology. We started with a study whose sample was obtained from the Portuguese military population, then we increased that sample and, finally, we conducted a comparative study that involved a sample with elements from Portuguese and Spanish military populations, to identify dental characteristics useful in forensic analysis for human identification.

In every study, regardless of its sample, we analyzed the behavior of each dental piece as an individual element, by studying the presence of clinical conditions in the generic codification.

We used the generic codification during the whole research project because it implies less subjectivity. This generic codification system allows grouping cases with similar clinical conditions into the same category, such as every restoration or every dental piece missing. Therefore, this more limited codification tends to reduce and correct some common errors intrinsic to the observer, such as failure in specifying the restored surfaces, the type of material used, the reason for missing teeth (either due to exodontia or uneruption), distinguishing between abutments and pontics, among others. This codification system simulates the process of dental data collection conducted by forensic odontologists.

Due to the wide variety of differentiating characteristics found (number of dental pieces, their anatomy, the particularities of their implantation in the dental arch, pathologies such as caries or periodontal disease, the different types of restoration, the diversity of materials used, missing teeth, prostheses, implants, among others), we can state that there are no two persons with the same dental arch. Furthermore, at least theoretically, there may be very many points of comparison in the study of dental pieces.

In the process of missing people identification, it is imperative to conclude the certainty degree or probability of the identification. In the current state of knowledge in Forensic Odontology, it is not possible to precisely estimate probabilities, as there is no knowledge of the exact frequencies of the various dental pathologies and treatments in the general population on which the identification is based. The only data that could be used for this purpose would be the frequencies of treatments and pathologies deducted

from the professional experience of dentists. Therefore, it is necessary to conduct scientific studies that objectively establish that diversity presented by the human arch.

Another common element in the three papers written is the origin of the population. We selected the military population because they are more exposed to additional risks during both peace and war missions. Furthermore, as it is well-known, military personnel must receive dental care before participating in missions, which increases the potential interest of Odontology in the identification process.

The Portuguese and Spanish military forces play an important role, since they participate in international missions, thus committing to fulfill the important responsibilities taken by Portugal and Spain before their peers at the North Atlantic Treaty Organization (NATO), European Union (EU) and United Nations (UN). Therefore, high expertise and assurance are required in the preparation of the Military Forces besides the operational training, including a thorough assessment based on selection criteria defined by NATO (EMFA, 2015). One of the main criteria established by NATO for military personnel to be considered eligible in the recruitment stage is their oral health status. Before their deployment, military personnel should fulfill the minimum oral health requirements set by NATO. Also, NATO medical units should "ensure clinical governance which provides a framework in which the medical services, and individual medical staff, are accountable for continuously improving the quality of their services and safeguarding high standards of care by creating an environment in which excellence in clinical care will flourish" (NATO, 2017).

Oral diseases are a significant public-health problem, and FDI considers them as an essential component of the general health status (FDIc, 2012). It is estimated that approximately 27% of the Portuguese population does not have access to oral health care or has access only in cases of emergency, and the main fundamental cause are financial limitations (CEDManual, 2015; EC, 2010; OMD, 2017a).

In the past years, several studies have been published (Martin-de-Las-Heras, Valenzuela, Luna, Bravo, 2010; Friedman, Cornwell, Lorton, 1989; Bradley, 2003) aiming to understand the frequencies of the dental treatments and pathologies in certain groups of the population, so that the likelihood of each of the diversities or treatment patterns of the population studied could be estimated from that data.

In order for the statistical analysis to be applied to the different clinical conditions found in teeth, the data collected from clinical histories filled by dentists should be computerized. Traditionally, each dentist uses their own codification for recording data in their clinical histories, collect that data manually, and do not store dental charts in a computerized format. In some cases, dentists acquire a specific software for managing their dental practice, and software manufacturers currently use the tooth numbering codification by quadrant that complies with international standards. That codification system is the one proposed by FDI, in which each tooth is identified by two digits – one for its quadrant and the other for its position in the quadrant, and quadrants 1 to 4 (starting in the upper right quadrant and moving clockwise) refer to the permanent dentition and quadrants 5 to 8 refer to the primary dentition.

Several studies (Martin-de-Las-Heras, Valenzuela, Luna, Bravo, 2010; Bradley, 2003a; Bradley, 2003b; Friedman, Cornwell, Lorton, 1989) have stored a vast number of dental charts electronically and proposed their own codification systems to create a database that could be posteriorly statistically analyzed.

When we started this research project, we contacted multiple organizations worldwide to understand the procedures they used and their awareness regarding the storage of dental records. We received several answers from those dental associations and concluded that, in most countries, the period of storage is established from the last intervention. We also verified that some countries establish additional specific deadlines in the case of children, complying with a minimum age for storing their clinical records. The most common answer for the period during which the dental records are stored was 10 years after the patient's last appointment/treatment. The countries with more-specific requirements for long periods were Israel, Russia, Finland, Island, Norway, South Africa and Argentina. Some of these countries have a high/moderate risk rating and give particular importance to these procedures.

On the other hand, other countries with more-tolerant or no requirements, such as Guinea-Bissau and Brazil, should be more aware, as their risk rating is moderate and high. These countries are not specifically sensitized to keeping dental records for a significant period, even though they have a higher likelihood of requiring these elements.

Some authors studied the qualitative and quantitative impact of storing dental records on human identification in a mass disaster in Asia, in 2005 (Petju *et al.*, 2007). In this situation, victims from Europe (76.4%), North America (76.5%), Oceania (86.7%) and Africa (75.0%) were identified mainly based on dental comparison. The rate of missing people identification based on dental records was significantly higher than when no dental records were available ($p < 0.01$). Most of the identified victims were sent back to their country of origin and their families four months after the disaster, and their clinical records were the main method of identification in 46.2%. However, among the missing Thai citizens, only 2.0% were identified using dental identification, of which 18.1% had dental charts and 0.8% had dental x-rays. It should also be noted that only 7.4% of the Thai dental records could be used for dental identification and that a third of Thai victims were not identified (Petju *et al.*, 2007). According to the Disaster Victim Identification (DVI), Forensic Odontology is one of the three main identifiers, along with fingerprints and DNA and, thus, a multidisciplinary team of experts is required in disaster cases (INTERPOL, 2014; Berketa, 2012; Lake, James, Berketa, 2012; Schou *et al.*, 2012).

Although there are some differences between countries regarding the obligation of storing dental clinical records for a certain period, most dentists who work in countries member of the EU should keep their patients' dental clinical records for a certain number of years. For example, in Spain, the article 17.1 of the law on clinical records obligations requires storing those documents for at least five years. In Portugal, the Recommendation 1/2013 of March 16, 2013, of the Ethics and Professional Conduct Committee (CDD) of the Portuguese Dental Association (OMD) refers that, since storing the clinical file is essential, dentists should store all elements that compose it for a minimum length of five years (OMD, 2017).

Proceeding with our research was fundamental for understanding the state of the art regarding information available nationally and internationally, and conducting the second paper, which aimed to analyze the Portuguese military population with more detail, was crucial.

During our research, we detected a big difference between men and women. Nonetheless, the sex distribution in our sample was quite similar to military population records referred by other authors (Mota Gonçalves, 2013; Coutinho dos Santos, 2011). We conducted a chi-square test that confirmed that the prevalence of the male gender was significant. This difference results from the fact that military service was mandatory

for men until 2003, the year when Portugal abolished the mandatory military service, and it became optional for the whole population.

Our sample's sex distribution is coherent with the military population records referred by other authors (Mota Gonçalves, 2013; OMD, 2010a). In our sample, the female proportion was coherent with the information available on the Portuguese military population, which states that in 2011, from a total of 17,592 military workers, 2520 were women. In 2008, the Portuguese Ministry of Defense, according to Decree no. 101 of July 6, 2008, stated that the recruitment of candidates for the military forces should respect gender equality and involve the access to every level and specialty. We believe that that law has contributed strongly to the increase of the female proportion in younger ages (Coutinho dos Santos, 2011).

Following this research, we concluded that it would be useful to have greater dental diversity, the comparison with other samples could bring new elements for the research, and the addition of some other variables, such as oral hygiene, diet, smoking habits, among others, could help find differentiating patterns in further studies.

Considering the interpretation of the elements developed in our research and the generic codification, we found that the teeth most often classified with the code “unrestored” were the inferior anterolateral teeth. These teeth are less exposed to dental caries processes, which would require more restorations, because they do not have an occlusal surface and are less exposed to direct injury, as they are protected by the maxilla. On the opposite side, the first and second molars are the teeth most prone to suffering diseases that require treatments by dentists. The code “restored” was the most common in these teeth due to the anatomy of their occlusal surface and their essential role in the masticatory process. The teeth with the lowest restoration rates were the inferior lateral anterolateral teeth due to the same reasons explained above regarding the code “unrestored.”

The code “missing” was the most frequent in the third molars. This finding may be associated with those teeth's anatomical conditions, as well as with their late eruption. On the other hand, the teeth with the lowest “missing” frequencies were the canines and the incisors, which are less often affected by pathological processes and, thus, less subjected to exodontia. Furthermore, due to aesthetic reasons, those teeth are less often extracted, and a greater effort is made to keep them.

Regarding the “crown” code, it should be noted that it was infrequent in every tooth. The first molars stood out in this category probably because they are the first permanent teeth to erupt early, thus being the teeth most susceptible to suffer from diseases that require treatments by dentists. Moreover, due to their anatomical occlusal surface, the first molars can require early prosthetic intervention. On the other hand, the teeth with fewer crowns were the third molars. This low frequency may be justified by the fact that crowns are highly unusual in posterior teeth and, when the teeth are properly positioned, both the patient and the dentist usually chose to extract those teeth before their restoration.

The younger group (≤32 years) had healthier teeth and fewer missing teeth, which may result from the several prevention programs that were recently implemented in Portugal. After previous oral health programs with a very restricted access since 1999, in 2009 Portugal's political strategy changed and increased its reach. The National Oral Health Promotion Program (“cheque dentista” - dentist voucher) was created to reach some groups of the population with a high risk of caries. This program includes healing and preventive treatments and provides financial support for oral care using private resources. This program was initiated by Decree no. 301/2009 of March 24, published in the Portuguese Official Journal, 1st series, no. 58, of March 24, 2009. Moreover, the Portuguese Ministry of Health has been developing strategies to improve the awareness, promotion and prevention regarding oral health in the public health system.

In Portugal, although oral health is included in primary health care, as mentioned earlier, it is provided mainly by private entities, with little or no public support. This situation is a significant challenge for the access to oral health care, especially to the population with poorer economic conditions, which is a significant group in Portugal (CEDManual, 2015; OMD, 2010a).

Some studies conducted in military populations showed that the prevalence of dental emergencies increases with age, being less frequent in the 20-30 years age range and more frequent in the >51 years group (Madiba, 2014). When we studied the age clusters, two clusters resulted from the standardization of the dental condition for every quadrant. Cluster 1 was more associated with younger people and Cluster 2 was more associated with older people. This distinction may be important to medical and legal areas for human identification, particularly in the age group >48 years. It is from that age that a more significant difference is observed between the younger and the

older populations. This observation resulted from the analysis of the two age groups in pairs mentioned above.

The fact that superior incisors and canines are healthier may result from younger people being more aware of aesthetic needs and, thus, following preventive oral health measures.

As referred in the first article, introducing populations from other countries would make the analysis more consistent and, therefore, the third article included a Spanish military population and aimed to comparatively analyze both populations.

In the study that incorporated the Spanish and the Portuguese military populations, the analyzed samples are representative of the studied populations and, thus, the results obtained may be extrapolated to the whole Spanish and Portuguese military populations. We believe the fact that the gender proportion was similar in both samples justifies the combination of the Spanish and Portuguese samples for the agreement analysis and analysis of the main components.

The similarities between the two samples were considerable. The sex proportion, as well as the general oral health status, did not differ significantly. The age distribution was also similar. To identify discriminatory elements in the population, we combined the variables “age group” and “dental characteristic” for each tooth.

The first, second and third molars showed a higher number of significant differences between the two populations. The teeth with the “restoration” treatment were more frequent in the Spanish population and the first molars were more frequently “missing” in the Spanish population, compared with the Portuguese population. The agreement level for the general oral condition was higher in the Spanish population, which may indicate that there is a greater concern with oral health in Spain than in Portugal. The highest agreement rates were found between the teeth pairs 41-31, 18-28, 11-21 and 48-38. This finding may be explained by the fact that pairs 41-31 and 11-21 are closer to each other and, thus, more exposed to similar levels of aggression in the oral cavity. Due to their visibility and to aesthetic reasons, patients may require equivalent treatments in those dental pieces. Dental pairs 18-28 and 48-38 are the last teeth to erupt and share similar characteristics regarding the limited space for their eruption and the fact that they are frequently missing in the oral cavity.

The principal component analysis identified seven components, of which sex and age correlated to each other, although no other correlations were found for the remaining six components with higher weights. These components involved dental characteristics and were among the teeth with similar positional characteristics or other similarities. The correlations found clearly reflect the anatomy and position of the tooth in the dental arch.

The dental patterns provide an excellent tool for comparison in human identification, similar to that of mitochondrial DNA. The literature suggests that there is enough dental diversity among people to allow establishing a human identification method scientifically developed for forensic purposes (Martin-de-Las-Heras *et al.*, 2010). The different nature of the dental anatomy and the placement of restorations may ensure accuracy when techniques are properly used. The diversity of dental patterns formed by combinations of missing, restored and unrestored teeth may be compared with the diversity of mtDNA sequences formed by combinations of variants in multiple polymorphic spots inside the mtDNA sequence. However, one of its limitations is the lesser stability of the dental pattern comparing with DNA (Martin-de-Las-Heras *et al.*, 2010).

Chapter VI. Conclusions and Perspectives.

To summarize, this research project was based on three main studies and allowed withdrawing the following conclusions:

The national consciousness on the importance of properly filling dental records is not generalized worldwide. Dental records should have good quality, be mandatory and be stored efficiently with easy access in case the identification based on dental pieces is required. Two important factors contribute to an effective human identification based on dental records: the regularity of the follow-up of oral health appointments and the quality of dental records, which the healthcare professionals are responsible for.

The generic codification showed to be of great help in forensic research processes, as it implies less subjectivity. This generic codification system allows grouping cases with similar clinical conditions into the same category, such as every restoration or every dental piece missing. Therefore, this codification is more limited and tends to reduce and correct some common errors intrinsic to the observer, such as failure in specifying the restored surfaces, the type of material used, the reason for missing teeth (either due to exodontia or uneruption), distinguishing between abutments and pontics, among others. On the other hand, the data collection process is less efficient.

The different clinical conditions found in dental pieces have a discriminatory potential on their own in the identification process and may even be individualizing factors when they are present only in a certain number of individuals, thus being able to form, either alone or together, a differentiating dental pattern. This differentiating potential should be valued regardless of the clinical condition, location, detail level and age of the person presenting it, as no minimum number of characteristics is required for a dental arch to manifest one singularity sufficient to make it unique.

The two populations compared in this study are similar regarding the gender proportion and the general oral health status. The agreement analysis showed that the observed correlation values for contralateral teeth were significantly higher than the ones obtained for antagonist teeth, in both populations. Furthermore, elements with a differentiating potential were identified in both populations, conferred by the type, frequency, location and level of detail with which each clinical condition was described or recorded. Our study established similarities and differences of dental conditions that may be applied as an auxiliary method in human identification.

Despite some limitations, this study leads us to highlight the potential of dental records analysis in the context of individual human identification. For that reason, we believe it would be useful to have a more detailed understanding of the dental records practices, both nationally and internationally, and the characterization of the Portuguese military population and the dental patterns of the Portuguese and Spanish military populations.

Our study also indicates the requirement of a larger sample size in order to obtain a more accurate representation of the military population, so as to better characterize the diversity of dental records. It is also important to collect data from other sources, generate more diversity and specify some additional variables, such as oral hygiene, diet, smoking habits, among others. Additional research on this area, especially with samples that offer more detailed information on dental characteristics, may contribute significantly to Forensic Odontology by facilitating the use of these characteristics both for positive dental identification and for excluding identities in the forensic practice.

Chapter VII. References

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Appendices

Appendix A - Authorization from the Ethics Committee of the D. Pedro V Military Hospital, Porto, Portugal

Hospital Militar de D. Pedro V
Avenida da Boavista, 4050-113 PORTO ☎+351 22 508 69 00

Comissão de Ética para a Saúde

Aprovação de trabalho de Investigação Clínica

Serve o presente para certificar que o trabalho de investigação clínica, intitulado "Diversidade de tratamentos dentários numa população militar Portuguesa e sua utilidade para a identificação Humana", apresentado pela Dr.ª Maria Inês Barreto Guimarães, como principal investigadora, identificado segundo requerimento que fica arquivado nesta Comissão, depois de analisado foi aprovado em reunião de 2010.09.20.

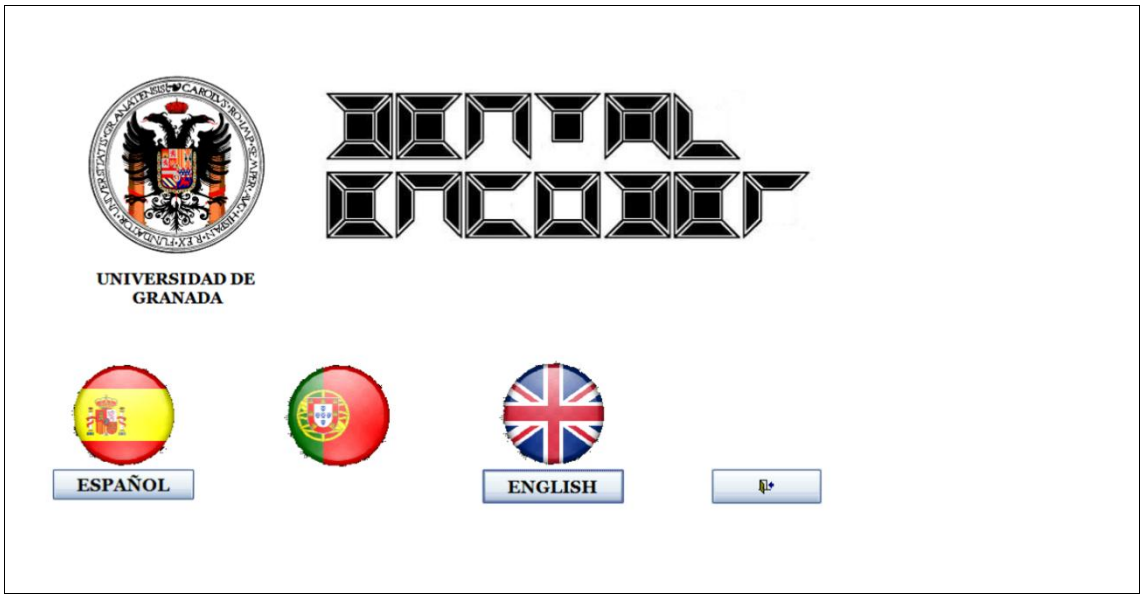
2010.09.20

O coordenador da Comissão de Ética para a Saúde

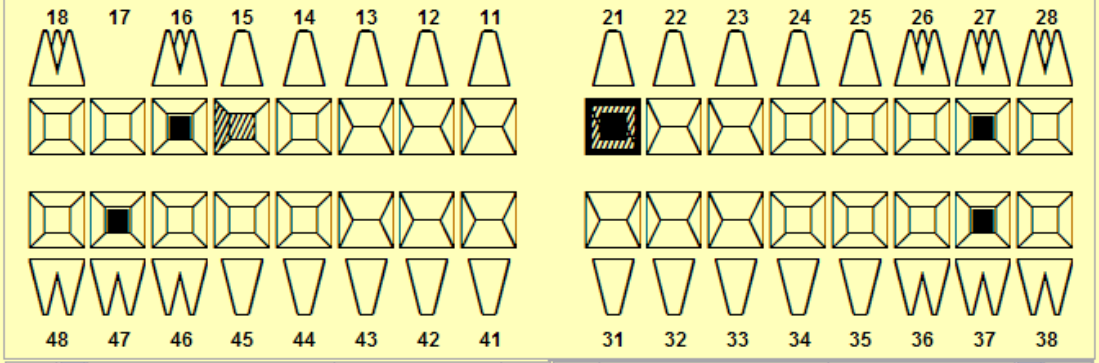
Joaquim Pinheiro, MD, Mestre em Bioética

Appendix B – Images of the DENTAL ENCODER and Sheet by INTERPOL

Appendix B1

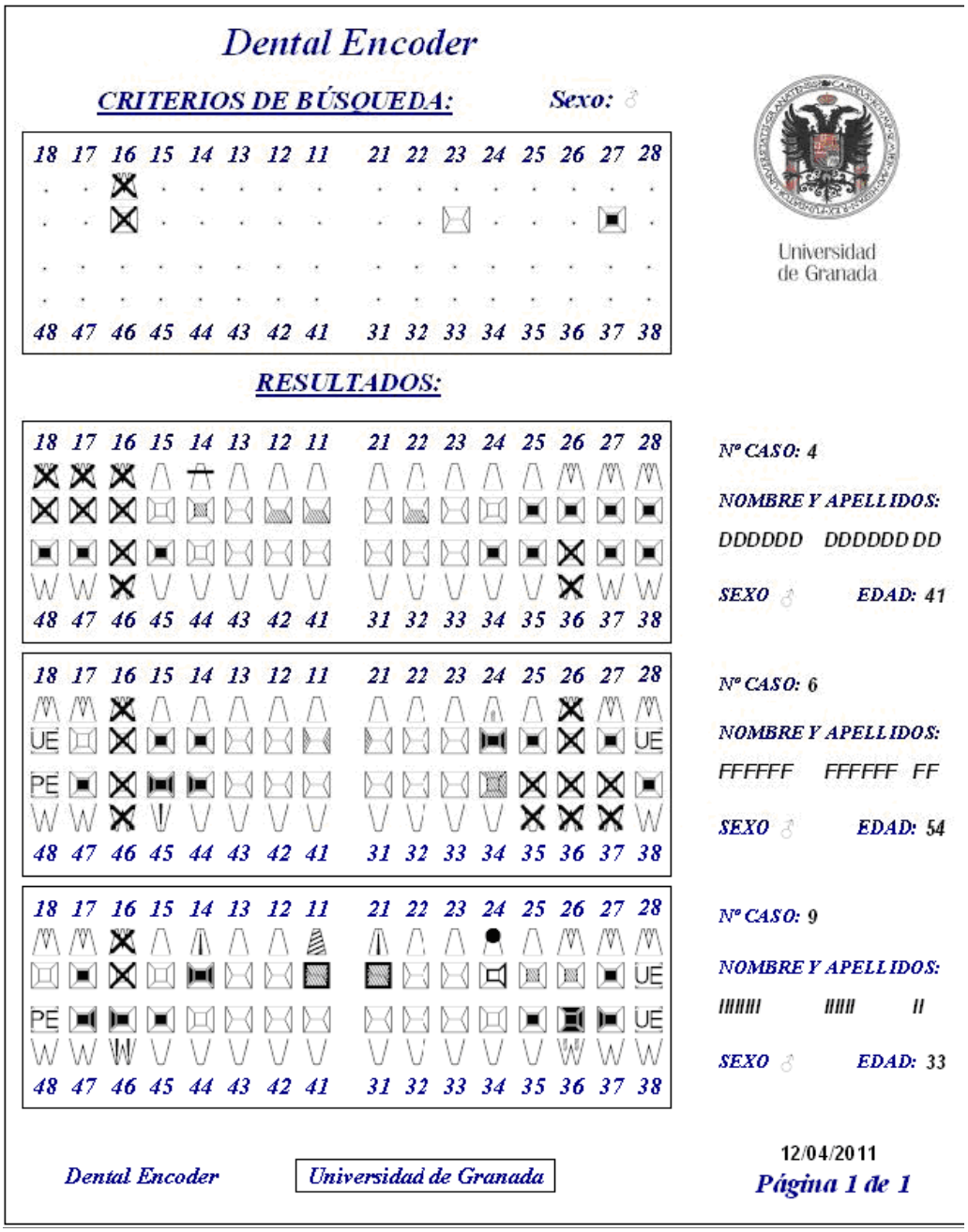


11	Sano		11	21	Corona M-Porcelana		21
12	Sano		12	22	Sano		22
13	Sano		13	23	Sano		23
14	Sano		14	24	Sano		24
15	Estético OD		15	25	Sano		25
16	Amalgama O		16	26	Sano		26
17	Sano		17	27	Amalgama O		27
18	Sano		18	28	Sano		28



48	Sano		48	38	Sano		38
47	Amalgama O		47	37	Amalgama O		37
46	Sano		46	36	Sano		36
45	Sano		45	35	Sano		35
44	Sano		44	34	Sano		34
43	Sano		43	33	Sano		33
42	Sano		42	32	Sano		32
41	Sano		41	31	Sano		31

Appendix B2


Dental Encoder
CRITERIOS DE BÚSQUEDA:
Sexo: ♂
18 17 16 15 14 13 12 11 21 22 23 24 25 26 27 28
48 47 46 45 44 43 42 41 31 32 33 34 35 36 37 38
Universidad de Granada
RESULTADOS:
Nº CASO: 4
NOMBRE Y APELLIDOS:
DDDDDD DDDDDD DD
SEXO ♂ EDAD: 41
Nº CASO: 6
NOMBRE Y APELLIDOS:
FFFFFF FFFFFF FF
SEXO ♂ EDAD: 54
Nº CASO: 9
NOMBRE Y APELLIDOS:
IIIIIII IIIII II
SEXO ♂ EDAD: 33
Dental Encoder
Universidad de Granada
12/04/2011
Página 1 de 1